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ENGLISH ELECTRIC RAILWAYS.

WE are thankful for the crumbs that fall to the electrical engineer from the British railway directors' table. They are slow in falling, but they are worth having; no doubt larger ones will follow when we have shown all the good that we can do on the North-Eastern in the neighbourhood of Tyneside, and on the Lancashire and Yorkshire from Liverpool to Southport.

We never were so rash as to suppose that our great railways would abandon their old and well-tried love in a hurry, or too eagerly embrace the new. It is true that our cautious railway men have long had their interest aroused by the newcomer, and have been casting longing glances in her direction—indeed, some notable advances have been made; but however anxious and hopeful we may be for electrification, we must not overlook the fact that among the strongest traits in the "make-up" of the British constitution are discretion and caution. This quality is one likely to make our progress substantial, as even our Continental rivals are now recognising in naval and commercial affairs. It is just possible, so far as sweeping changes are concerned, that there may be nothing more granted to the electrical engineer until the railway works now arranged for have been carried out and have demonstrated practically what can be accomplished.

It cannot be said that anything of very great consequence is recorded in the reports and speeches which have received attention at the railway meetings held in London during the past week or 10 days. It is not news to learn that the Metropolitan and District lines are getting on with their electrification. There has been another good half-year for the City and South London line from Clapham to Islington; in fact, it has been the best six months since the railway opened, now so many years ago; the line has carried more traffic, paid a higher dividend, and brought its percentage of working expenses down lower, than ever before. The Waterloo and City Railway, it is pleasing to learn, has also, in spite of the fewness of its opportunities for traffic expansion, succeeded in earning a dividend in excess of the South-Western's guarantee. The Central London, in the face of atmospheric troubles and multiple unit conversion operations, pays the same dividend as in the previous half-year, and carries a much larger sum forward. These are all interesting and important facts, of course, as demonstrating that it is possible for some tube lines to carry enormous traffics with safety, and also with profit, notwithstanding their heavy capital expenditure.

We cannot conceal our disappointment that there is to be delay in the opening of the Great Northern and City Electric Railway. There is not to be an immediate opening, as many of us had been led to think, for the directors have come to the conclusion that they cannot—presumably as economically as would otherwise be the case—operate one section of the system alone. They will wait another 12 months for the completion of the Finsbury Park Station,

so that operations may commence over the whole length from Finsbury Park to Moorgate Street at once We do not question for an instant the wisdom of this policy, for the great bulk of the traffic will be obtained at Finsbury Park, at any rate in the initial stages, but it is none the less disappointing. It is small comfort to be told, as we were at the meeting on Tuesday last, that this, that and the other part of the system is "practically" finished, and that experimental trains of 150 tons have been run at 40 miles an hour over sections, when there is to be no public service for quite another year.

It is satisfactory to learn, as readers will do from our news columns to-day, that the necessary details respecting the electrification of the North-Eastern Railway have at last been settled. The contracts have now, after quite matured deliberations, been placed with the Thomson-Houston and Westinghouse Cos. respectively. We suppose we are safe in presuming that the necessary machinery and apparatus will be manufactured at Rugby and Trafford Park. It was pretty well a foregone conclusion that the contract would go to one or other of these companies for execution. It would be a pity for work of such importance as this is to English electric railway traction, to go out of the country to be done. Another English factory, the famous Preston works of Dick, Kerr & Co., Ltd., is engaged with one of the most important pieces of railway work that electrical engineers are concerned in at the present moment—we refer to the conversion of the Liverpool—Southport section of the Lancashire and Yorkshire Railway.

The Mersey tunnel railway will, doubtless, be running electrically very soon now, for the Westinghouse Co. has practically finished its work, and various trial runs have, we believe, been made. An important improvement has been effected by the acceleration of the traffic on the Liverpool Overhead Railway during the past year.

The only other topic upon which we can touch in this article, is that of London traffic. We approach the subject with much diffidence, for he is a bold man who can say what is going to happen here. We may leave the L.C.C. tramways almost out of account for the moment, for they do not materially affect the heart and centre of the metropolis. When Mr. Balfour can see his way to appoint it, we are to have a Parliamentary Commission to inquire exhaustively into the whole situation. We saw it written somewhere only the other day that this Commission would be appointed in a hurry, would carry its proceedings through with almost unheard-of expedition, and would issue its report in time to indicate the proper course for Parliamentary Committees to pursue in respect of the new tube projects which are down for consideration almost immediately.

We do not, however, think that this is likely to prove correct, for the problem is of too vast proportions and of such consequence to present and future generations that it cannot afford to be hurried or shirked. We imagine that if anything approaching to finality in the matter is to be arrived at, it will be only natural to call expert evidence from all parts of the world where real efforts are being made to deal systematically with the teeming multitudes who have to get to and fro in large cities. To call together experts for such a purpose, to hear their evidence, and then to give it the serious attention which it imperatively demands, and last of all to prepare and publish a report worthy of being handed down as an authoritative document on the subject is not a task for a few weeks or months. That is one reason why we are just now very much in doubt as to what will be the future of the "tubification" of London.

The Law of Motor-Cars.

In another column to-day we make reference to the progress which is being made in the motor-car industry. It is not an inopportune moment therefore to refer to the chaos which reigns supreme in the administration of the law relating to automobiles. The existing regulations as to the speed of these vehicles on highways are absurd; are habitually disregarded, and last, but not least, are practically incapable of enforcement. This last assertion may be qualified by saying that the greater the offence the smaller the chance of the offender being brought to justice. Again, the great unpaid, to whom the administration of the law is for the most part entrusted, have adopted no uniformity in the principle under which they administer the law. In some counties if it is proved upon the evidence of a constable that a speed of 12 miles an hour is exceeded, the driver of the car is fined without any regard to the state of traffic on the highway at the time. In other counties the magistrates appear to interpret the Act and the regulations of the Local Government Board in a more liberal spirit. Finally, to indicate the hard state of the law, it is sufficient to mention a case which came before the High Court, where the driver of a motor-car was accused of infringement of the regulations by driving recklessly and without due regard to the public safety. It was held that the magistrates were justified in convicting, although there was no evidence that there was any traffic, or that there were any people on the highway at the time. "Hard cases make bad law," is a saying that has more than age to commend it, and it would seem to be a hard case when a motor-car driver is fined for driving on an open road where there is no risk to anyone. In the circumstances and with a view to obtaining a change in the law, a committee of the Automobile Club have issued a "blue book" which contains a statement of what the law is, and what, in their opinion, it ought to be. They have also published a speech made by Mr. Chaplin, the draughtsman of the Light Locomotives Act, 1896, in which he expressed the opinion that the law should be amended. Another useful feature of the blue book is a report of a deputation made to Mr. Long, and in reply to which the then president of the Local Government Board declared that in *his* view there was room for an alteration in the law. If the draughtsman of the Act, and the president of the Local Government Board are of opinion that the law should be amended, there would seem to be some probability of an amending Bill being brought before Parliament in the next session.

Some Proposals.

The following proposals for reform have been addressed by the Legislative Committee of the Automobile Club to the County Council's Association:—

"1. *As regards speed.*—The limit of speed of 14 miles an hour provided by the Act of 1896 to be maintained, but power ought to be given to the Local Government Board to permit higher speeds under regulations to be issued by the Board. It is proposed that the regulations of the Board should provide that the limit of speed of 14 miles an hour shall remain in force in all cases except the following:—

When a motor vehicle is being driven on a portion of straight road into which there are no cross or by-roads running, by the side of which there are no houses, and on which there are no horse-drawn vehicles, horses or cattle. In such a case there should be no limit to the speed of the vehicle."

"2. The Committee agree that motor vehicles should have marks of identification which may be easily read by passengers on the highway. They think that whereas numbers are associated in the minds of the public with hackney coaches, &c., names are in common use for the identification of houses, ships, yachts, boats, houseboats, &c., and would not, therefore, convey any stigma. The Committee recommend that motor vehicles should have painted on them, in letters about 3 in. high, the names selected by their owners, and that underneath the name there should be painted the initial of the register in which the car is registered."

"3. The Committee lay great importance on the new Act providing a ready form of appeal by a motor driver against the decision of magistrates. There is a precedent for this in the Married Woman's Summary Jurisdiction Act."

"4. The Committee are opposed to its being possible for a motor driver to be prosecuted for driving to the common danger. Since a Court of Appeal have decided that a vehicle may be driven to the common danger, although there are no passengers or cattle or vehicles on the highway, the Committee think it should be necessary to prove that a motor vehicle is driven to the danger of life and limbs of passengers *at the time* on the highway."

In our view the most important of all the above recommendations is that which relates to identification. The difficulty is that the faster the car the greater the chance of escaping justice; while a car which cannot exceed the statutory limit by more than a mile or so is inevitably caught by the police. In France all cars capable of travelling at great speed are treated as suspects. Mr. Long, in the course of his reply to the deputation to which we have referred above, expressed the hope that the Automobile Club may be able to formulate some practical scheme of registration which would establish a complete and easy means of identifying every car in the kingdom. In our view this can only be brought about by the use of numbers and the establishment of local registrations offices under the general management of a central office in London. In whatever respect the legislation may see fit to amend the laws, we trust that attention will be given in the first place to this question of registration, and in the second place, to the abolition or modification of the present absurd speed limit.

Motor-Cars for Electrical Work.—The Bradford Corporation has lately put into service a motor telescopic tower for the inspection and repair of the overhead wires in connection with the electric tramways. The car, which was supplied by Messrs. G. F. Milnes & Co., Ltd., of Hadley, Salop, carries, in addition to the telescopic tower, all the necessary tools, and is thus ready to be instantly despatched to the scene of any breakdown.

The New York Telephone Co. has also just put in service an electrical motor-wagon for the transport of heavy reels of telephone cable, and for the pulling of the same through the underground conduits. The latter is effected by means of an electrically-operated windlass on the wagon, and is found to effect a considerable saving in both time and labour, as compared with the practice of pulling the cables through the conduits by hand.

City and Guilds.—At the Mansion House on Tuesday last week the prizes and certificates awarded to students of the colleges and schools of the City and Guilds of London Institute were distributed by the Lady Mayoress.

Fatality.—The British Westinghouse Co., who hold the contract for electrifying the Mersey Railway, have a large staff of men employed on the work. Last Saturday week as two of them were engaged in the tunnel, near the low-level station in Bold Street, Liverpool, they were knocked down and killed by a train from Birkenhead.

SHIP LIGHTING.

By FRANK BROADBENT, M.I.E.E.

Although, nowadays, every ship of importance is electrically lighted, we cannot be said to have evolved what might be called a standard system; nor is it customary, except in one or two shipyards, to find any provision made in the design of a vessel, for the reception of the wires or the generating plant. A ship's installation is, in fact, generally carried out as though it were an afterthought, and is looked upon as an unmitigated nuisance, both by the builders and by other sub-contractors.

When the wiremen start they are always in the way, and appear to be ubiquitous. Their work must necessarily follow the builder's work, as it is impossible to fix casings, tubes, fittings, or the various accessories until there are bulkheads and decks to fix them to.

And this is how the trouble begins. It is not sufficient that the bulkheads and decks should be merely in place with open spaces here and there for special panels, mouldings, plates, &c.; the electrician wants a clear uninterrupted run for his circuits before he can profitably make a start. He cannot afford to carry out the work piecemeal, running a portion of one circuit here and another there, leaving a gap to be filled in when he can get a chance, he must get right ahead when once he begins, owing to the extreme sensitiveness of the labour item in this class of work, an item which is more sensitive in ship work than in almost any other.

And by sensitiveness is meant the susceptibility to outside influences, or conditions, of the cost of labour, which always tends to exceed the estimated amount. This want of stability, so to speak, of the cost of labour, applies to some extent to all large buildings in the course of construction; but there are so many trades concerned in the building of a modern ship that the risks of hindrance or complete stoppage are much greater than is the case in the usual run of land installations. On the other hand, it is possible to so crowd the ship with men, in order to rush the completion, that it is almost impossible for the electricians to keep pace and finish their work by the time the vessel is ready for sea.

Under these circumstances it is a matter requiring considerable experience and judgment to hit the psychological moment when it is not only profitable to start the wiring but when there is a reasonable chance of completing the work before the vessel sails. It requires also the exercise of a certain amount of diplomacy to satisfy the builders, owners, or consulting engineers, who in the early stages begin panicking for a start to be made, that the time is not ripe for the work to be proceeded with.

Generating Plants.—In the ordinary cargo steamer it is not an easy matter to find a place for the generating plant, as every inch of space in the engine room is wanted for something else; and the plant must be in the engine room if it is to receive any attention at all. No electrician is carried, as a rule, and attention to the electric plant is but one more thing added to the duties of the engineer on watch.

Under such conditions the best possible position for the dynamo is on the starting platform, that is to say, in the starboard recess on the bottom platform, as here it stands the least chance of being overlooked.

This, of course, applies only to single-screw steamers. In twin-screw engine rooms there is no suitable place on the bottom platform, and the best position, if no electrician is carried, is in one of the side recesses of the top platform, that is, on a level with the cylinder tops.

It is advisable to set the machines so that their shafts lie in a fore-and-aft position, and not 'thwartships. Although plants have been set in the latter position and may have so run satisfactorily, still, on the basis that there is on the average more rolling than pitching, and that ships sometimes have a permanent list to starboard or to port, there seems to be no doubt that the fore-and-aft position is the better. The bearings of fast-running shafts placed 'thwartships must be subjected to severe strains by the rolling of the vessel, due to the well-known gyrostatic effect.

Some 10 years ago belt-driven and endless-rope driven dynamos were not uncommon on board ship; friction wheel

drives were also used, to a lesser extent, but all these have now given way to the direct-coupled set, and this, at any rate, may be considered a standard arrangement.

It may seem somewhat curious that bipolar dynamos are more common than multipolars (except in Admiralty work), more particularly when it is considered that there is less stray field in the latter type, and consequently less liability to produce compass deviations due to magnetic leakage. The chief reason, however, is that, generally speaking, the whole machine must be above the level of the deck on which it is fixed. The shaft centre of a multipolar is generally considerably higher than in a bipolar machine of similar output, and as the deck level marks the lowest point of the magnet frame, it necessitates raising the engine, to bring its shaft in line with that of the dynamo. Height is just one of the things one cannot get on board ship, and this reason limits the choice of engine between a very few makers when sizes of, say, 25 H.P. and upwards are considered. We are considering an ordinary merchant ship, in which no special provision has been made for electrical machinery.

Allowing a couple of inches for a wood seating, there is, as a rule, not more than about 6 ft. clear height from this to the underside of the deck beams, and rarely more than 7 ft.

Sufficient clearance must be allowed to remove the cylinder covers and withdraw the pistons; so if we allow 9 in. for this and 9 in. for the under bedplate, the height of the engine itself, not including the cylinder grease cups, should rarely exceed 4 ft. 6 in., or 5 ft. at the most; with a single cylinder engine it is generally possible to dodge the beams so as to get the cylinder between two, and thus utilise the full height between the decks; but this is not always possible with compound engines, nor where two sets are installed. It is found, therefore, that the ordinary compound engines designed for land work are quite unsuitable, in the larger sizes, for ship work.

As already stated, these remarks apply to ordinary cases in which no special provision has been made for electrical machinery. In cases where a special dynamo room can be built, more headroom can be obtained, or if this be not possible, some portion of the deck beams may be cut away and a skylight fitted through which the pistons may be lifted. It may, however, be accepted as a general condition that engines for dynamo driving on board ship should be as compact as possible, not only as regards height, but also in the overall dimensions of length and width.

Governors.—As to governors, it is now the usual practice in good work to use automatic expansion shaft governors, which act directly on the slide valve, varying, with varying loads, the throw of the eccentric.

From the point of view of steam economy, there is probably very little advantage in the automatic expansion over the throttling type of governor in these small sets. The average-sized generating set is for about 110 lights, and from careful tests made on board ship on one of this size, the coal consumption was found to be at full load 1 lb. of coal per 16 C.P. lamp per hour. The engine was an 8 in. × 6 in., running at 250 revolutions per minute, with a boiler pressure of 80 lbs. per sq. in. This was the actual consumption over a period of 12 hours for steam generation only; the coal required to keep a constant pressure in the boiler with the stop valve closed was found by a separate test and deducted from the total amount used.

The result is perhaps not expressed in very scientific language, but it is practical, and is the information the sea-going engineer wants.

Under these conditions then, the saving of a pound or so of steam per unit is not vital, and the question of type of governor is not decided on this ground, but rather on the basis of reliability.

A belt-driven governor is absolutely useless on board ship. The belt quickly becomes saturated with oil and water, and slips on the pulleys, refusing to drive the governor, and in the end the engineer throws it off and regulates the speed as well as he can by the stop valve.

Although the automatic expansion governor is very generally used, there are one or two points of advantage in the direct-acting throttle type. In the first place, the latter is capable of adjustment whilst running, and the ordinary expansion governor is not; also, when a standard sized engine is used at a low speed, the steam pressure being fairly high, the throttle governor is often better owing to the insufficiency of fly-wheel power at the lower speeds, under which conditions the automatic expansion governor does not always control the speed satisfactorily, but allows the engine to hunt.

Steam and Exhaust Service.—In the early days it was a common practice to connect the electric engines to the auxiliary steam pipe service. This, however, is very bad practice from the electric light point of view. The pipes are possibly quite large enough for the winches and cranes, in which constant steam pressure is not required, but when the dynamos are running their speed rises and falls each time a winch is stopped and started. The only really satisfactory arrangement is an entirely independent steam service direct from the boilers, with a change cock or valves to change from main to donkey boilers, and with a reducing valve if necessary in the high-pressure service. The exhaust pipe should be led direct to the condenser through a change cock or valves, by means of which the engines may exhaust to the atmosphere when the condenser is not working. The atmospheric exhaust needs somewhat carefully arranging, as there is always a tendency for condensed water to accumulate in the pipe, more particularly when the pipe is connected to the exhaust main from other engines. The danger is that, in suddenly changing over, which is sometimes necessary, from condenser to atmosphere, water may rush back to the engine, causing serious damage. This happened once in the writer's experience, and the result was not quite what might have been anticipated. Instead of knocking the cylinder end out, the back rush of water brought the engine to a dead standstill on the up stroke of the piston.

The engine appeared to be none the worse for the shock, but, curiously enough, the whole of the lamps that were alight at the time flashed up and burnt out, due to the inductive effect of the sudden stoppage of the armature and the consequent demagnetisation of the field.

Dynamos.—As has already been said, the two-pole dynamo is still the standard for ordinary ship work, and unless accumulators are employed it is almost invariably compound wound. When two or more dynamos are installed on a vessel, they are not as a rule run in parallel, but on separate circuits, these being provided with change-over switches. Unless an electrician is carried, this is without doubt the safest and simplest arrangement for marine engineers. Low voltages are still employed, 60 to 65 volts being quite common. For lighting purposes this is satisfactory enough, and has the advantage of being suitable for arc lamps run in parallel for cargo purposes, and for searchlights up to 20 in. in diameter, such as are used in passing through the Suez Canal. The introduction of electric power for ships' winches, cranes, &c., will no doubt eventually result in higher pressures being used, but progress in this direction is unaccountably slow. Prejudice and conservatism are probably the causes of the backwardness, and it is somewhat remarkable that in this matter the Admiralty ships are ahead of those in the mercantile marine. On account of the large use of searchlights, 80 volts was until recently the Admiralty pressure, which for 24 in. and 30 in. projectors is more suitable than the lower pressures mentioned above. Owing to the increasing use of electric power, the Admiralty pressure has been raised to 100 volts in recent work.

Switchboards and Fuseboards.—When the back of a switchboard is accessible, as in most land installations, there is not much objection to back connections. On board ship, however, it is rarely possible to get at the back after a board has been fixed, without taking it down again. In small sizes it is occasionally possible to hinge the boards, so that they may be swung away from the bulkhead in order to make or examine the connections. Even then it is not the simplest matter to connect up the dynamo and circuit cables, nor can one be sure that no nut or connection has slackened during the movement of the board. In the case of a large board the difficulties of connecting up when all connections are at the back are considerable.

The board must be propped up at a short distance from the bulkhead whilst the connections are made, involving all sorts of queer attitudes and contortions on the part of the

wiremen, who have very little room to work in. Then the board must be forced back and fixed, the loose cables crossing and crowding each other, straining or loosening the terminals and sweating sockets, and forming a very undesirable and unsafe arrangement.

(To be concluded.)

POLYPHASE WORK IN 1903.

By A. C. EBORALL.

In this article the writer gives some general remarks on the present position of heavy electrical engineering, as far as alternating-current work is concerned, indicating some of the lines upon which such work is progressing at the present day, and those which it is thought are likely to be followed in the near future. The present time is quite favourable for reviewing the subject in this way, as, on the one hand, alternating current work is now being extended along well-defined lines, while, on the other hand, there have been several developments within the last two years (at present almost unnoticed in this country) which are likely to influence future work to a considerable extent.

Dealing first with alternating-current systems, it is noteworthy that, up to the present, single-phase systems have not made the progress that certain consistent supporters had hoped for and predicted. On the contrary, it is significant that not one single-phase system of any magnitude has been put down within the last two years, while many have been converted to direct current, with the help of a polyphase transmission, or else into polyphase systems altogether. These single-phase systems were for the most part arranged for working at 83 or 100 cycles, with unsuitable generating plant, and an uneconomical distribution, and as extensions became necessary the engineers responsible for them had to choose between adding unsuitable plant to an out-of-date, inconvenient and uneconomical system, or re-modelling the system altogether. It is satisfactory to see that the bolder step has been taken in the case of the more important systems, one result being that it is only a question of time before the high frequency copper type alternator becomes extinct. But, while the conversion from high frequency single-phase to standard frequency two-phase (which involves no scrapping of existing feeding and distributing systems) is certainly a logical and effective manner of solving a somewhat difficult problem, yet it is difficult to justify the entire conversion of a large system from alternating current to direct current working, unless the area is one that can be fed directly from a single direct-current power station. Otherwise, the heavy additional cost of putting down and operating numerous sub-stations equipped with running machinery, the cost of the alterations to the feeding and distributing networks, together with the heavy conversion losses, are out of all proportion to any small advantages that the direct-current distribution offers.

In this country, the two-phase polyphase system has made considerable headway, but the writer considers its use should be limited to converted systems, because the old concentric cables can be used with it; for new schemes it presents no advantages over the three-phase system, while in certain respects (copper economy, for instance) the latter system is superior. A pure three-phase system of transmission and distribution, when properly laid out, is quite as simple to operate and to regulate as any single-phase system; regarding the latter point (regulation) it is now beyond dispute that no difficulties in balancing, &c., arise, if the generating plant is suitable, and if *three-phase* transformers and induction motors are used throughout. The *general* system of the future, for new work outside the sphere of pure direct current working, is hardly likely to be anything but a three-phase system of transmission and distribution for lighting and power at a standard frequency (50 cycles), with converting sub-stations for the street tramways.

This leads up to the question of choice of frequency and of sub-station machinery. Regarding the former, it is gratifying to see that for new schemes one of the two standard frequencies has been adopted in nearly every case, namely, 25 cycles for pure railway and tramway work in which rotary converters have been employed in the sub-stations, and 50 cycles for general lighting and power work. In this connection, however, it is a matter of regret to see that for one of the largest schemes now in course of construction (Mr. Yerkes's various underground railways) a new frequency has been introduced, namely, 33⅓ cycles, for which there would appear to be little justification, even when the nature of the generating plant is taken into account.

The frequency of 50 cycles is excellent from all points of view, except for the operation of rotary converters; the latter work admirably at 25 cycles (or thereabouts), but at this frequency arc lighting is impossible and incandescent lighting very indifferent. Thus these two frequencies become naturally identified with the two principal classes of work for which alternating current is usually employed, namely, (*a*) the transmission and distribution of electrical energy for general purposes, and (*b*) its transmission for railway and tramway work alone.

The practical necessity for employing motor-generators in connection with conversion work from 50-cycle systems has led to the adoption of 40 cycles in one or two cases, with the idea of enabling rotary converters to be used should any great amount of converting work have eventually to be done. As is well known, these machines are superior to motor-generators with regard to first cost and efficiency; on the other hand, they are undoubtedly less reliable (when working at frequencies above 25 cycles), and not so easily regulated as motor-generators. The amount of floor space required in the two cases is about the same, but the rotary converter sub-station is the cheaper. For pure traction work, the balance of advantages undoubtedly lies with the rotary converter, provided that the operating conditions are favourable, and for this reason attempts have been made to obtain these favourable conditions in connection with general schemes of power transmission and distribution by adopting for them a frequency of 40 cycles, as already stated.

At the present time it is not possible to say whether this compromise can be considered as being thoroughly satisfactory. On the one hand, it is the lowest frequency that can be used with success for general lighting and motor work; without doubt, it is inferior to the standard frequency of 50 cycles in these respects. On the other hand, it has yet to be proved that rotaries of large size can be operated from a 40-cycle circuit in a manner which will fulfil the stringent requirements of the present day, especially if slow-speed generating plant is employed. Until the results of further experience are available, it must be a matter of opinion as to whether a frequency of 40 or 50 cycles is best suited to a large general scheme, in which the requirements of all classes of work have to be fully considered. The writer is unhesitatingly in favour of the standard frequency of 50 cycles for such a scheme, with synchronous motor-generator sub-stations for the tramway work, and considers that something will be done in the future with very high-speed motor-generators in this connection—for instance, 500 KW. plant (operating, of course, at high pressure on the motor side) running at, say, 1,500 revolutions. In conjunction with steam turbines, Parsons, Brown and others have successfully built both direct current and polyphase generators of this size, running at 2,000 revolutions, and at this time of the day a combination of the two classes of machine should present no mechanical or electrical difficulties. A high-speed motor-generator equipment of this character would undoubtedly compare very favourably with the rotary converter equipment with regard to first cost of plant and buildings, and its efficiency would be somewhat higher than that of the standard motor-generator equipment.*

In any case, the choice of frequency will become of considerable importance in connection with many of the large power schemes now contemplated; it is by no means an easy

* Since writing the above, the writer has been informed that such a high speed equipment has been recently proposed in connection with some important sub-station work in the North. In this case, however, it was suggested that induction motors should be used.

matter to lay out a large scheme of this kind in such a way, that every class of work likely to be met with can be successfully and economically catered for. Commercial success with most schemes can only be ensured with low capital expenditure and running costs, together with the ability to handle successfully all classes of work from a uniform system of transmission and distribution, and it is in connection with this last point that the question of frequency becomes of special importance.

As already indicated, it is hardly likely that future work outside the sphere of direct-current working will be carried out, in any case, with anything but a three-phase system, and if three-phase traction systems were commercially possible, the whole question of sub-station equipment would disappear. But it must be admitted that at present there is but little prospect of this possibility arising, for, quite apart from technical considerations, any system of three-phase street traction is, at any rate as far as this country is concerned, quite out of the question. For practically the only tramway work yet to be done is extension work in connection with systems at present at work, or new tramway systems linking up the large towns (already having direct-current systems of their own) with the surrounding districts, and smaller towns and villages. A uniform system of street traction is evidently the only one possible for this country, employing standard direct current tramway material, and operating at 500 volts, the system being arranged, as far as possible, on standard lines with regard to gauge, overhead work, &c.

The technical difficulties in the way of three-phase street traction in towns are sufficiently obvious. The cost and complication of two overhead wires, the difficulty of making them perfectly safe, and the objections to them from the æsthetic point of view, are objections which are almost insurmountable, even if minor troubles, such as interference with telephone circuits, &c., are not counted; in a town such a system would necessitate the abandonment of overhead work in favour of a conduit or surface-contact system. In addition to this there are the purely electrical objections, namely, the lagging currents, inefficient operation of the motors at different speeds, the uneconomical starting of the motors, and the difficulties in connection with the pressure regulation of the system, the net result of which is to necessitate the provision of generating plant about 50 per cent. greater than that required in the corresponding direct current case. For underground railway work, the first-mentioned objections naturally hardly come in, and for such cases the objections to a three-phase system are principally in connection with the frequent starting and necessary rapid acceleration, and turn, for the most part, on the question of economy in first cost and in operation.

While it must be conceded, for the reasons briefly indicated above, that the highly-developed and standardised direct current traction system is the only one worthy of consideration for the operation of street cars and short lines of railways, yet, on the other hand, there can be no question that for light railways on the one hand, and for long high speed lines on the other, the three-phase equipment, even as it stands to-day, will fulfil the requirements of each case in a perfectly satisfactory manner. In both these cases, the continual starting and stopping is not required, and the question of acceleration is of minor importance; in both cases, also, the provision of sub-stations containing running machinery for feeding the overhead conductors would be altogether too costly. Again, the possibility of working at much higher pressures on the trolley lines than is now usual constitutes a great advantage, especially for heavy work, while, as the recent Berlin—Zossen trials have shown, the three-phase motor (the speed of which, it must be remembered, is controlled on the low pressure rotor circuits) is particularly adapted to the requirements of a very high speed service.

In the near future three-phase traction work in connection with light railways and with high speed main lines must come to the front. The type of equipment that will be adopted will probably be multiple unit, with rheostatic speed control in the rotor circuits of the motors, as, for such work as this, the advantage of a pole-changing device or a "tandem control" of the motors is counterbalanced by the disadvantage of the additional complication thereby brought about. A frequency of 25 cycles, or thereabouts, will be selected as being the best from the point of view of motor speeds and the reduction of inductive effects in the transmitting system, and in the overhead conductors and the rails, while the pressure on the stator terminals of the motors will be 1,000 volts or more for really heavy work. The motors may be compensated for their wattless currents (see below), the power station generators will have to be compounded for constant pressure at the feeding points, and the collection of the current from the trolley lines will be preferably carried out by means of "side collecting" bow collectors.

(To be concluded.)

METHODS OF CHARGING FOR ELECTRICITY.

By C. ORME BASTIAN.

In a paper entitled "Tarifications de l'Energie Electrique," published in *l'Eclairage Electrique* on December 6th, 1902, the author makes a telling point in drawing attention to the fact that the charge to the consumer for electricity cannot only be based upon the cost of production, and that in other industries other elements are often taken into consideration: citing, as an example, the fact that a circular in an open envelope, and a closed letter, though both weighing the same, will be delivered from the same address to the same destination and with the same expedition, at two distinct rates.

The number of different tariffs discussed in the paper illustrates the complexity and difficulty of the problem of how best to serve the interests of the consumer and the supplier, and it ends with an unqualified summing up in favour of the "two-rate" system, whereby a high rate is charged during the period of maximum load on the generating plant, and a lower rate at all other times.

This system undoubtedly possesses the advantage that the cost of production can be taken into account by fixing the high rate at a figure that will cover the standing charges on the plant installed. In addition, the why and the wherefore of the two rates can readily be explained to, and comprehended by the ordinary layman—if he cares to go into the question; but in the great majority of cases he will accept the arrangement, and pay a certain rate between 6 and 8 p.m., and a lower rate at other times without analysing the reasons for the charge, as he knows definitely at what period he should economise, and contents himself with surmising that the supply of electricity must be similar in its conditions to that of strawberries or other seasonable products.

Another variable tariff system, based on the maximum demand of each individual consumer, has the initial failing that such maximum demand may not correspond with the period of maximum demand on the generating plant, and here we have the necessity for the introduction of the time element.

Under the general conditions of supply now prevailing, an ideal but utterly impracticable system would be obtained by the use of a time-switch in combination with a demand indicator, the latter only being switched into circuit during the period of heavy load at the electricity works.

Apart from the fact that the maximum demand system does not discriminate between the cost of supply at mid-day, and the cost during the evening (the consumer consequently being encouraged to restrict his temporary excessive demand during the day, when such demand would really benefit the supplier), it is, moreover, an exceedingly complicated system to operate, and as generally practised, its whole basis is undermined by the fact that a consumer can have his demand indicator disconnected on giving notice to the supplier that he intends to exceed his normal demand on a definite occasion, and it would not seem to affect the question whether he can make use of this privilege once, twice, or oftener per annum.

On the grounds of simplicity and general fairness, therefore, we must incline to favour the opinion that the "two-rate"

system has distinct advantages over the maximum demand system, whilst the Hopkinson method of charging appears inadmissible for the sound commercial reason that it tends to restrict the number of electric lamps installed, and therefore extends a helping hand towards the various rival methods of lighting.

The best possible variable tariff cannot be regarded as in any way a permanent solution of the charging problem. All of them must be based on existing conditions, and existing conditions at the present time will not remain permanent.

It is noteworthy that the "peak" of the load curve of some provincial gas companies is attained between 12 noon and 1 p.m., owing to the cooking stoves in use and the introduction of electric light, but who could have foreseen 10 years ago that these two innovations would combine to bring about such a change in the conditions of the gas trade?

The circumstances attending electricity supply are varying from year to year, and they will continue to vary even on different days in the week, and the perfect variable charging system—probably complicated in itself—must be further complicated in order to be adjustable to all possible varying conditions.

Numerous supply authorities, who originally started charging on the maximum demand system, are now offering an alternative medium "flat rate," thereby relinquishing any benefit they might obtain from the fact that the former system certainly discouraged the use of electricity by consumers who cannot be profitably supplied on a low "flat rate" basis. Other authorities, acting on the strength of their own practically-acquired convictions, have gone over to a "flat rate" entirely, and others would like to do so if they could make up their minds to face the capital loss consequent upon the change.

It seems inevitable that the ultimate system of charging must be the simple "flat rate," with a discount on a sliding scale according to the number of units consumed; and this being so, the policy for the electrical engineer to adopt is to strain every nerve in reducing the cost of production, and increasing the efficiency of his lamps; and incidentally it may be pointed out that the cost of his inspection and clerical staff, and the amount of his capital charges, will be sensibly reduced when he discards the use of maximum demand indicators, time switches, and duplicate meters.

The good and bad consumers must be taken as they come, and a profit sought on the total turnover, just as in other industries.

The aim must be to make the turnover as large as possible at a fair average profit, and to reduce the cost of production in every available practical way. The selling price will then come down, and consumers will be obtained quite as quickly as the manufacturers can supply plant to meet their demands.

Even at the present time there is no variable system of charging that can justify its existence by any *conclusive* evidence of increase in profit or reduction in works costs, that might not have been attained by means of a moderate "flat rate" with a carefully thought-out sliding scale of discounts.

The long-hour consumers are those who, in the very nature of things, will most appreciate the advantages of electric over other methods of lighting, and the industry can safely rely on these advantages to attract the custom of those to whom they will most appeal; the deterrent influence of heavy quarterly accounts in the case of small householders being successfully overcome by the extensive introduction of prepayment meters.

As a temporary expedient, the small shopkeeper and publican, whose business premises are open up to 10 p.m. and later, might perphaps be supplied at a predetermined specially low rate of discount, without infringing the provisions of the "undue preference" clause of the Electric Lighting Act, 1882 (Sec. 20), the legal consideration being that the premises will be kept open and the light used for a certain number of days per week up to a certain hour, and the interests of this class of consumer, who benefits most under the maximum demand system of charging, could be thus provided for in a simple and sufficiently fair and exact way to meet all practical requirements.

A special charge for street lighting could also be arranged, and this should preferably be the only exception to the strict "flat rate" with discount, which system presents all the essentials of permanent suitability.

AUTOMOBILES AT THE CRYSTAL PALACE.

We referred last week to the automobile show held at Earl's Court, London. But excellent and interesting as that exhibition was, it pales into insignificance in comparison with the one which is now open—it closes to-morrow—at the Crystal Palace. It has been arranged by the newly formed Society of Motor Manufacturers and Traders, a fact which has assured its being thoroughly representative of every branch of the rapidly growing manufacturing and trading operations which this country is now carrying on in motor-cars and equipments and parts therefor.

To sort out the electrical features at this extensive show, without the aid of an official catalogue, were a well-nigh impossible task to perform in the course of a few hours' visit. The management is therefore to be congratulated upon the comprehensive catalogue which it has compiled for the use of visitors. It was of considerable assistance to us in sorting out the electrical from the petrol and steam exhibits, an occupation not altogether like seeking needles in a haystack, but getting on that way. Yet though the electrical exhibits are comparatively few, they are more numerous and important than we have seen at any previous automobile exhibition in England.

We shall perhaps be using a commonplace if we remark that the automobile of 1903 is a far more gainly-looking construction than was that of any preceding year, and a dozen times more acceptable in design than was the automobile of motor-car emancipation year, 1896. Six years' exercise of inventive ingenuity, together with six years' careful attention from the coach-builder and the motor-equipment manufacturer, have worked marvels. Who shall say what the next six will accomplish? We falter when we touch this phase of the subject, for electrical progress is sometimes given to springing surprising developments upon us; we believe, however, that all electrical engineers whether in England, America or on the European Continent, are of opinion that the advantages which steam and petrol cars now possess over the electromobile will by that time, if not earlier, have come over to their side. And if that should happen, what a mighty work there would be before electrical engineering! But we will not indulge in grandiose prophesyings or roseate forecasts, for in this matter we own to being upon even less certain ground than our meteorological authorities are in theirs. No doubt some will blame us if we leave one particular matter unmentioned. Perhaps it ought to be taken into account—we may by the year 1909 have a few more practical commercial data respecting Mr. Edison's famous battery, and then who shall say our electromobilism nay?

From this introduction, digression, or whatever it be termed, we must return to the less speculative ground of the Crystal Palace and its exhibits. A pretty correct idea of the stands at which the visitor will find electrical carriages, or cars, or things for use in connection with them, also ignition devices, may be obtained from a glance at the list given below:—

Stand No.	Exhibitor.	Exhibit.
2.	H. M. Hobson, Ltd. ...	Electro-catalytic igniter (sparking plug).
6.	Walter Mills & Co. ...	Aluminium alloy castings.
11.	W. H. Wilcox & Co., Ltd.	Oils, jacks, tools and stores.
12.	Peto & Radford ...	Batteries, contact breakers, electrical measuring and battery recharging apparatus.
17.	G. Straus & Co. ...	Gearing and accessories.
39A.	London Electromobile Syndicate, Ltd.	Two electric runabouts.
41.	Eugen Baedeker ...	Accumulators, magneto ignition, and small electrical apparatus.
50.	Albion Motor Car Co. ...	Albion cars with "Albion" magneto ignition.
51—54.	O. C. Selbach ...	Six cars, "Spitfire" accumulators, &c.
62.	Henry Waterson ...	"E.H." induction coils, switches, &c.

Stand No.	Exhibitor.	Exhibit.
64—66.	Philipp & Co. ...	Magneto ignition.
78.	Wilson & Pilcher, Ltd.	Electric ignition.
79 & 80.	Auto-Carriage Co. ...	"Bardon" magneto ignition.
86, 87 & 88.	De Dion Bouton, Ltd.	Large number of cars. An 8-H.P. combination engine and dynamo.
104 & 104A.	E. W. Hart. ...	Electric landaulette and Victoria.
111, 112 & 113.	Humber, Ltd.	4-H.P. combination motor and dynamo.
120.	Electromobile Co., Ltd.	Electric Victoria, single landaulette, double ditto, electric coupé, brougham. Also chassis.
121 & 122.	Anglo-American Motor Car Co.	Baker electric runabout, Imperial and Stanhope. Also Vehicle Equipment Co.'s electric vehicles.
129.	Simms Manufacturing Co., Ltd.	Magneto machines.
130.	Langdon-Davies Motor Co.	Petrol cars with novel spring underframe.
131A.	G. T. Riches & Co. ...	Battery charging sets, Ecsemann high tension magneto igniter, &c.
140 & 141.	Brush Electrical Engineering Co.	Various cars.
147.	Electric Battery Co. ...	Batteries, coils, &c.
147A.	Longstreths, Ltd. ...	Lithanode batteries; carriage lighting, &c.
148A.	W. J. Bishop & Co. ...	Accumulators, ignition coils, &c.
153.	H. W. Van Raden & Co.	Accumulators, measuring instruments, charging and resistance boards, coils, &c.
155.	Pritchetts & Gold, Ltd.	Electric runabout car.
159.	J. Kaye & Sons, Ltd. ...	Oil cans, &c.
164.	City and Suburban Electric Carriage Co.	Electric Victorias, 15-passenger omnibus, landaulettes, runabouts, &c., also a special combination petrol-electric vehicle.
171.	Williams Counter Skid Syndicate.	Car with patent counter-skid.
183.	Stern Bros.	Lubricators, oils and greases.
184.	S. Smith & Son, Ltd. ...	Timepieces, speed indicators, &c., for motor-cars.
186A.	Long Acre Motor-Car Co.	Anti-skidding device.
187A.	Birmingham Aluminium Casting Co.	Aluminium castings for motor-cars.
188.	Automotor Accessories Co.	Timken roller bearings, Pflueger accumulators.
213.	"Bat" Motor Manufacturing Co.	"Bat" instantaneous switch, accumulator case, &c.

We have no doubt that many of our readers in the neighbourhood of London, if they have not already done so, will either to-day or to-morrow avail themselves of the opportunity of inspecting some of these excellent exhibits. We believe that this Crystal Palace show is to become a yearly event in future. At any rate, the matter is settled for next year, the date being already fixed for January 29th to February 6th; there is to be a first ballot for space on March 16th next. The arrangements are in the hands of Mr. F. W. Baily, secretary and manager.

(*To be continued.*)

CORRESPONDENCE.

Speedy Tramcar Erection.

I would suggest that Mr. J. W. Smith should read my letter again, and *as written*; he will then see that he has put his own suitable meaning to my words. I did say I would not question his piece of work, and at that time I did not intend to do so, but I further thought it just to give a lift unknown to these men who had been working against time. Little did I think Mr. Smith would give way to such feelings as he shows, and, in fact, I did not think my *facts* would upset the equanimity of the most sensitive.

How many men worked on Mr. Smith's 135-car job before him, and before July, 1900?

How many men were in his gang, and how many women, what were *they* doing, and why?

He should give the actual date of commencing the 135 cars and date of finish, and then allow the readers to judge.

I said 75 cars were handed over during the last three weeks of November (not nine weeks), and not one was sent back to the contractors, nor were their men fetched to any, not even for being improperly put together.

Now, if Mr. Smith means that 100 men and women can do more work than 18 men all told, then this correspondence becomes a quibble, and is not worth the paper it is written on.

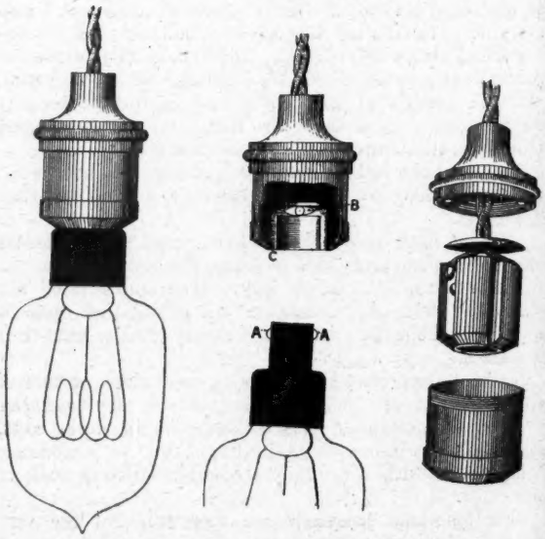
Not One of the Gang.

The Bayonet Lampholder.

I am pleased to find that Mr. Lundberg is of the opinion that something better than the bayonet lampholder is wanted for high-voltage work.

The lampholder he refers to, made by Messrs. Downie and Adams, was manufactured under my patent, and is the one I referred to in my previous letter.

I now enclose an illustration of this, and trust you will be able to find room for its insertion. The interior of the holder consists of a block of porcelain having a recess at one end to receive the cap of the lamp; inside this recess is a ring shaped groove with two leading-in grooves at opposite sides. On the outside of the cylinder are two slots containing spring contacts having terminals at the upper ends; the ring groove breaks through into these slots, and the spring contacts are there furnished with a small indent B. The cap of the lamp is made of vitrite, and has two contact studs, A A, at the upper end which connect to the respective ends of the filament. To insert the lamp, the two studs are passed through the leading-in grooves to the ring groove, the cap is then rotated through 90° in either direction, when the two springs close upon the studs with a snap owing to the points of the latter engaging the indents B.



It will be seen that the lamp is held independently of the outside case, while on looking into the holder from the lower end, no contacts can be seen. I may mention that I have had this holder connected with a 550-volt circuit, the wires from the two studs being led away to five lamps burning in series, and have inserted and removed the cap with perfect safety.

The best improvement made in late years to the bayonet holder has been the small ridge introduced by the Edison and Swan Co., as it increased the *surface distance* between the lamp contacts. This is a point your correspondents have overlooked, as condensed moisture on the top of the cap will cause extremely low resistance between the contacts.

The many attempts to bolster up the holder to make it suitable for high-voltage work are, no doubt, very ingenious,

but the fact remains that the best separation to be obtained even with a ridge, could not be greater than $\frac{3}{8}$ in.

H. Bevan Swift.

4, Bloomsbury Street,
January 31*st*, 1903.

The Institution of E.E.'s Building.

In your issue of the 16th ult. I see that the I.E.E. has sent out a circular asking the *students* to subscribe to the Building Fund. Personally, I am very much against our possessing our own building, on account mainly of the tremendous expense to be incurred in erecting a building to be occupied (except by the library and officials) for three or four months in the year. It is, of course, an open question whether we should have our own building or have a grand central building to be used conjointly with other large institutions, certain portions of which should be retained by each society or institution for library, offices, &c.

This, however, is not the reason for my troubling you, but I do think that the appeal to the students is rather a mistake. It means an appeal to the parents of students (for the latter are earning, in many cases, no money), and the parents are, in many cases, paying very heavily for the training of these lads. Is it not, therefore, rather a mistake to appeal to the *students?*

M.I.E.E.

February 1*st*, 1903.

The Sugden Boiler.

Referring to your editorial note to Mr. Ed. Wyrill's letter in your issue of January 16th, I notice that you call attention to the interlocking device Messrs. Babcock & Wilcox have lately started making for use on their superheaters to prevent the dangers that must otherwise arise from flooding. I wish to state that I have had these devices at work for about six months on a battery of four boilers, and have found them in every way satisfactory.

The principle of the device is as follows:—A spanner is used for opening the flood cock, and when the flood is open this spanner cannot be removed, nor can it be taken off until the flood cock has been shut and the superheater drained and the drain cock shut. The spanner is then removable, and is taken off the cock and used to unlock a device on the boiler stop valve which prevented that valve from being opened. When this is unlocked, the spanner cannot be removed until the valve is shut and the device locked. The spanners are so designed that they are not interchangeable from boiler to boiler, but can each only be used on its own boiler. In this way absolute safety is obtained, and no such accident as that alluded to by Mr. Wyrill can take place. The device can be, and in this case was, applied to the existing valves at a very trifling expense.

With reference to the flooding of the superheater, I wish also to point out the advantage of this, as it entirely prevents overheating of the tubes, and also acts as an auxiliary heating surface. If used in conjunction with the interlocking gear described above, there is absolutely no danger.

A. J. Hedgcock, A.M.I.E.E.

Beckenham.

[Our reference to the want of interlocking gear was made in March, 1900, and we described one introduced by Messrs. Lovell & Co., in May, 1901. The arrangement of Messrs. Babcock & Wilcox, described by our correspondent, appears to be extremely ingenious.—Eds. Elec. Rev.]

Re Fulham Baths Fatality.

I have read with the greatest interest the whole of this correspondence which appeared in the Electrical Review, and which has been (except for the last letter) in last week's issue, quite to the point.

I must ask this question:—"Why should wiring contractors who have quite sufficient rules set them by the supply companies to carry out their work efficiently be bothered with an inspector (practical electrician) to survey the work? It would come to this:—That what the practical electrician of the fire insurance company condemns, would be found in order by the inspector of the respective supply company, and probably *vice versâ*, and would certainly lead to the question of who is the master."

G. Stegmann.

The Wiring of Buildings.

In reply to "Foreman," it is undoubtedly the case that on a wet day, or when the temperature suddenly falls, a lower insulation test will be obtained with a metallic conduit installation than when the weather is warm and dry. This will be due to condensation of moisture in the atmosphere on the cold surface of the china fittings or the interior of the pipes, or both. Naturally, if the pipes are well earthed, the effect will be more marked, but directly the fittings are taken off, and the ends of the wires freed, surface leakage will be impossible, and the test will be higher. Of course, if the insulation has been torn off the wires, or weakened at any point, a low test will be obtained, and eventually there will be a dead earth at this point. If china or marble fittings were separated from the pipes by ebonite nipples, or even by an air space, the test would not be so low in wet or cold weather, and although the objection might be raised that this would not be a watertight system, it can at once be said that no system of pipework is sufficiently air-tight to avoid condensation owing to barometric changes.

It is really best to well ventilate such a system, and, if possible, to have an opening in a boiler room and another on the roof, so that warm air can circulate through the pipes.

The Writer of the Article.

"Foreman's" experience of low tests on damp days is quite a common one. In new buildings especially, the surface moisture at switches, ceiling roses, &c., gives no end of trouble at the test, unless the remedy is known. Some inspectors allow for such leakage when proved; some don't.

Referring to the earthing of tubing, I notice that in the issue of January 23rd, Mr. Prentice, in his article "On Metallic Protection for Conduits," gives an example of a leakage to a gas pipe, and consequent fire. I may be wrong, but I think that that is a mistake. The premised *metallic continuity* of the tubing, and the *efficient* earthing (designed for such an occurrence), would present a path of much less resistance than the partial contact of the compo pipe, unless the length of tubing is assumed to have a very high resistance in itself, which it would scarcely have in practice.

My experience of wiring is that there is nothing to beat a good lead-covered twin-wire system, protected where necessary.

Twin Wire.

Croydon, *January* 31*st*, 1903.

Your correspondent, "Foreman," appears to be passing through troubles which presented themselves to me years ago. I have always insisted on 600-megohm wire by leading makers. Say half a mile of it is put into a building. The insulation of the wire should be 1,200 meg. The actual test may show anything below 1 meg. What becomes of all the rest? Experiments proved that the ordinary white china bases of switches and ceiling roses were frequently very inferior insulators, owing probably to some foreign ingredient of a metallic nature. Also that the slate bases of switchboards and fuseboards "leaked like a riddle," when at all damp, and were never good insulators at any time. The remedies which I adopted were successful, and may be useful to "Foreman" if he have any influence as to the way in which his work is to be carried out.

1. Every switch and ceiling rose has an ebonite patera $\frac{3}{4}$ in. thick between it and the wall or ceiling. Each patera is screwed to a wooden wall block by ordinary wood screws. Each china base is secured to the ebonite by small brass *bolts*, having square heads, and placed as far apart from the aforesaid screws as possible. The screw heads and the bolt heads are sunk below the surface of the ebonite and covered with paraffin wax.

2. Every switchboard and fuseboard has separate slates for positive and negative terminals, with an air space between the slates.

3. Each screw which secures the slate to the wood framing is surrounded by an ebonite bush having a collar between the slate and the wood.

4. The outer edges of the slate do not touch the wood anywhere.

6. No joints are allowed on any conductors serving fuseboards, and as few as possible on the lamp wires.

5. All brackets are provided with an insulator between the lampholder and the bracket.

In one country house containing 500 lights, the insulation to earth of existing wiring was about ·015 meg. After I had introduced the improvements described, the insulation went up to ·50 meg., notwithstanding some damp places in the premises.

A building in this neighbourhood wired on the same lines gave 1·5 meg. for 428 lights. Many others could be named, but probably these will suffice as examples. All testing was done with 500 volts.

If the premises be lighted from street mains, the house mains must be *withdrawn* from the supply fuse terminals when testing. It is not sufficient to remove the fuses. Sometimes the supply fuse mountings are, in themselves, the worse sinners.

Henry Lea.

February 2nd, 1903.

I have been very glad to see the course of correspondence which has lately appeared in the Electrical Review upon the subject of wiring, as I think it is high time that some check is put upon the jerry wireman and his master, who, by their low prices, seem to obtain in some towns all the business.

I think I am right in saying that in no other trade is it so easy to deceive the public as to the quality of the material and workmanship they pay for, and this deception is very often helped by the supply companies themselves, by passing a job simply because the insulation resistance of the installation has reached their required standard, thus leaving the impression with the consumer that everything is thoroughly satisfactory, which is very often far from the case. For instance, this test does not show whether the wires have been encased throughout and are of sufficient carrying capacity, &c. There are many other of the fire insurance rules which the supply company's inspector very seldom troubles about, and of course it is impossible for him to do so thoroughly without viewing the work during progress.

I think the suggestion made by Mr. Mautby Hall in your last issue *re* the fire insurance companies combining to keep a competent inspector (who, by the way, should be a thoroughly practical man), to view work in progress in every town is a very good one, and would further propose that contractors should pay so much, according to the size of each installation they carry out, to cover the cost of this overlooking, which would, I am sure, well repay the conscientious contractor, and would at the same time raise the standard of electric wiring.

Fair Competition.

I thoroughly sympathise with "Foreman's" grievance regarding low tests on damp days. I know from experience that there is much to mend in the way of official testing by Corporation inspectors. I would like to state that so far as Edinburgh inspectors are concerned, we could desire no better than we have at present, so that my remarks do not apply to the inspector but to the rules which it is his duty to enforce, and a great many of which are nothing more or less than "Red Tape," (which, in my opinion, is not good insulation).

Let us take "Foreman's" case. He gets 5 megohms, say, on Monday, the inspector comes and tests on Friday, and gets 1 megohm on each conductor and probably ·5 between. If I were the inspector, no one could convince me that the drop was due to damp, for I have no proof nor can I find any, so the inspector must be one gifted with a fair amount of common sense and a fair knowledge of things electrical. But here is a more annoying case. A first-class maker of motors sends a motor, say, of 5 H.P. to me; it is addressed to my customer, and on its arrival is put down in its place. When it left the makers three days before, it was testing 25 megohms, when I get it, it is testing 10 megohms. I apply for a test, and have to wait, say, three days, and when the inspector comes he finds the same motor testing ·5 megohm. 10s. 6d., please.

Now I can't easily remove this motor from its position, and I know if I could get the current through the fields for a few hours and put a cover over the motor, I could raise the test, but I am not allowed to get current, and if I take it off the lighting circuit I am breaking the rules; still, I can't get another test till the motor is testing better and I have paid a 10s. 6d. fine because the weather changed.

Excuse the vulgarity, but I think this is *pure rot*. Further, I am convinced there is nothing that goes to make workmen fake their jobs (so as to get a successful pass), like the fear of imposing a fine on their employers of 10s. 6d. I know that four such fines each week would pay the wage of a tester, so that if he comes to my job for half an hour, I have to pay 10s. 6d. if it fails. I think it is nothing short of extortion. If the burgh engineer comes to test drains and these do not prove satisfactory, he comes back again without any fine.

I think that in the interest of the public and contractors this 10s. 6d. fine ought either to be removed or a charge of 1s. 6d. per hour made to the contractor for the tester's time, which is a very fair allowance.

On the other hand, should the inspector find the work has been scamped, then I think a fine of 10s. 6d. should be imposed. The scamping could then be traced to the individual, and the fee paid by the defaulter.

Megohm.

The Fuel Value of Town's Refuse.

Mr. de Segundo's very courteous letter in your last issue clears up the point, which was somewhat obscure in his article, that town's refuse has a "fuel" value.

On the general question of the primary object of a destructor we are apparently in entire agreement.

There are, however, two points of detail raised in the letter which I must notice, lest it should be inferred that I fall in with Mr. de Segundo's argument.

The first is as to the steam consumption per unit in small generating stations. I pointed out, clearly as I thought, that the consumption figures on a maker's test load had no bearing on the question.

The average consumption throughout a period of 12 months includes pumping, drainage, and stand-by losses, &c., and a perusal of statistics dealing with this point, say, Mr. Hammond's Institution paper, on the "Cost of Electrical Energy," will show that many stations consume more pounds of *coal* per unit than the figure Mr. de Segundo assumes for *steam*.

He is looking at the question from the wrong point of view.

The second point is the evaporative value of the heat units used. Mr. de Segundo's argument is unquestionably incorrect. It is immaterial whether the heat units are used for raising steam, heating feed-water, or both; the equivalent value in pounds of water evaporated from and at 212° F. is obtained by dividing the whole of the useful heat units by 966. I am sure that, on reflection, he will see that this is so.

I must thank him for his very kind references to my articles, and for the extremely courteous tone in which he discusses the little points of difference between us.

Frank Broadbent.

5, Bond Court, E.C., *February 3rd*, 1903.

Tramcar Brakes.

The article "More about Brakes," which appeared in your issue of the 23rd ult., has brought forth a protest from an engineer of the Westinghouse Co.—a kind of lamentation that the writer of the article should not be aware of the fact that the Westinghouse brake has actually been in

operation in this country for two years. Did the same "Engineer" write the article in *Engineering* which you criticised?

About two years ago we were in need of a good track brake for a hilly electric tramway system for which we are consulting engineers, and though we searched the country over, we could not find one—not even a Westinghouse brake—so we had to design one ourselves. As a good many people now know, the outcome was our pneumatic track brake, which has been in use ever since. It has been adopted in five large towns, and has the record of never having failed as an emergency brake, and as a service brake of quadrupling the life of the car wheels.

Since the pneumatic track brake has now had nearly a two years' trial of unqualified success, it may be said to have had "the only real trial, that of life," and if reliable tests are sought, we can best refer to those made by a representative of the Electrical Review, and published in your issue of November 21st, 1902.

On the Continent, where higher speeds are permitted than are in vogue on street tramways in England, pneumatic brakes are becoming universally adopted. Careful investigation has proved that power brakes dependent upon the electrical equipment of the cars are dangerous and unreliable. We suppose, as usual, that England will in course of time follow their lead after dearly bought experience shows that it is wise to do so.

Hewitt & Rhodes.

Electrolytic Meters.

In reply to "Consumer's" letter, appearing in your last issue, we can only again ask the question—what is the difference between the destruction of record in maximum demand indicators and Bastian meters, except that the indicator is reset much oftener than our meter is refilled?

Of course there are always people like "Consumer" who are looking for trouble with gas and electric companies, and their other natural enemies, but when they dispute their accounts, the matter is settled by the simple expedient of charging on the basis of their average consumption, provided it can be settled in no other way.

If "Consumer" omitted to count his change before leaving a shop, no notice would be taken of any subsequent claim he might make; the meter and indicators are the counters over which electricity is bought and sold, and an eye should be kept on their readings.

We think it is quite clear that with systematic management no trouble need occur through the destruction of record, be the meter, Bastian, Reason or any other type, and we deduce this from experience gained in the case of demand indicators.

We should be glad if "Consumer" would inform us who it was that told him that "Bastian meters had a bad effect on the lamps," so that we may test this disinterested individual in the following way:—We will connect the meter in circuit with a lamp on a 220-volt circuit, we will then tap the meter, in or out of circuit, with a short circuiting key, while the observer has his back to the lamp, and we will confidently guarantee that he cannot tell whether the meter is in circuit or not by turning round and looking at the lamp.

Anyone can try "Consumer's" idea regarding "judicious tipping," and thus induce the meter reader to open the motor-meter and turn back the hands a few units, though he may be detected, and committed with the meter reader for conspiracy to defraud.

That the Bastian meter has no effect on the brilliancy of the lamps we offer to demonstrate to any one by an object lesson; and that it is the most accurate continuous current meter on the market we are also prepared to demonstrate.

As the Electrical Co., Ltd., have discreetly retired from the field, and have not accepted our challenge published in your issue of January 9th, we beg to make it clear that this was extended to *any make* of motor-meter, and we will now further extend it to those of the *shunted* electrolytic type, like the Reason meter, as we are anxious to show Messrs. Chamberlain & Hookham that the claims we advance in respect of our goods are not to be likened to the statement that "Beecham's pills are worth a guinea a box."

We have shown that we are prepared to take upon ourselves the onus of proof, and if our fair proposals are not accepted, there would appear to be no further need for us to trespass further upon your valuable space.

The Bastian Meter Co., Ltd.

Chas. O. Bastian, *Managing Director.*

February 3rd, 1903.

Since your correspondent "Consumer" admits in his letter, which appeared in your last issue, that he is ignorant of the subject on which he writes, his letter would not be worth noticing were it not that he makes an insinuation which he would find difficult to substantiate, viz., that the Bastian meter affects the light prejudicially. I would, therefore, advise "Consumer," instead of being content with his ignorance, to try a simple experiment for himself, and see if he can detect the smallest difference in the illumination when a Bastian meter is in circuit, with a normal pressure exceeding 200 volts, and when it is cut out.

That "Consumer" has no desire to make the personal acquaintance of a Bastian meter on his own installation is easily understood. No doubt he finds it gratifying to get something for nothing, even if it be only the energy consumed by a single 8-c.p. lamp, which most motor-meters would be incapable of registering, but which a Bastian meter would most certainly make him pay for.

"Consumer" further states that Mr. Bastian's answer with regard to the destruction of records is not conclusive, and cites a case where he would have been charged extra through an error of the meter reader, though the error would have been re-adjusted in the following quarter. He argues from this that "without a continuous record, he would evidently have been a loser." Why? On the contrary, if "Consumer" had had any experience of Bastian meters, he would know:—

1. That it is much easier to read a Bastian meter than a motor-meter, and that, therefore, it is very improbable that the reader would have made the mistake at all.

2. That a Bastian meter is always read twice, and generally by two different men, at the time of refilling, so that the chance of any error is practically eliminated.

3. That continuity of reading is of less importance than accuracy of registration.

That this is so is proved by the fact that large numbers of corporations and companies are in the habit of removing motor-meters on their circuits for the purpose of re-testing them at periodical intervals, thus obliterating the records for the far greater advantage of making them and keeping them as accurate as possible.

It is to be hoped that "Consumer's" brilliant idea of judicious tipping will not be acted upon by others, the corruption of public officials being not only looked upon in an unfriendly light by their employers, but distinctly discouraged by the Legislature.

Apologising for the length of this letter.

Haydn T. Harrison.

Commercial Management of Electrical Tramways.

I have read with pleasure in your issue of the 30th ult. the comments of Mr. C. H. Wordingham on the above article in the January number of *Feilden's Magazine*, and I thank him for his broad-minded criticism of one or two of the points which I endeavoured to make; I will now endeavour, as briefly as I can, to further explain some of my statements.

I quite agree with Mr. Wordingham that the carriage of goods by tramways is surrounded by many difficulties; this question should properly be treated under two headings:—

(*a*) Carriage of light parcels.

(*b*) Carriage of heavy parcels.

By heavy materials I mean, of course, the raw material for, and the produce from, the staple industries of Lancashire. In my article I especially stated that Lancashire was, perhaps, the best centre in England in which such a scheme could be successfully operated, and still I maintain that before many years are over we shall see goods in large

volume, both heavy and light, carried by this means, notwithstanding the supposed inflexibility of the system when compared with motor-wagons.

I admit there might be difficulties in arranging the carriage of light parcels between different points, and I would further admit that, following present practice, such a system could only be advantageously established for delivery to suburban districts; it would certainly be more difficult to arrange for the delivery of goods in the town itself. In the large residential out-districts the tramway system should establish depôts from where the goods could be easily transferred and delivered to the residents, say, within the radius of a mile or so, by small vehicles. This would entail but one handling at the terminus.

It is interesting to note, in connection with this question, that the Manchester Corporation Tramways Department are alive to the possibilities of revenue from this source, and they have evidently decided to start, as a separate branch, a goods and parcels delivery department to work with their present system, for they have, within the last month, advertised for a goods and parcels manager. This addition to their service will, I venture to say, prove the beginning of an enormous carrying trade on their system; it marks, in my opinion, an important point of departure in the history of the Manchester tramways undertaking.

I quite accept Mr. Wordingham's statement that many difficulties will arise in the transportation of heavy goods; I take it, however, that he would not include in his objection the ordinary class of merchandise and warehouse material belonging especially to the Manchester trades. I will readily admit that the carriage of heavy castings and similar materials might be held to be outside the scope of a tramway system under ordinary conditions; I think I made mention of this in my remarks relating to tramways running in conjunction with light railways.

To meet Mr. Wordingham's objection, with which I agree, that the heavy goods traffic in cities is already unbearable, I suggested that goods transported by tramways would minimise the objection to a considerable degree; the traffic would be better under control, and would prove less noisy.

I regret that Mr. Wordingham thinks my ideal unattainable as regards the carriage of coal, coke, building material, and similar goods, as I certainly hope that tramway systems will offer in the future facilities for the transportation of such materials on very favourable terms to contractors. Take the case of the New Midland Grand Hotel, Manchester, where most of the materials have been brought on to the ground by lorries and ordinary carts, it is a case in point; had the quarries and brick works been situate near Manchester, every ounce of the material could have been cheaply transported right on to the ground by the tramway system during the night, provision being made for a special track running on to the ground so as not to delay the ordinary passenger service. There are hundreds of similar undertakings which could be catered for by the tramways, and I maintain that, with suitable care, the feature would not be so hideously ugly as imagined by some critics who have not yet awakened to the possibilities of what our tramway systems will do in the interests of commercial progress. I still look forward to the added disfigurement with cheerful philosophy—the bugbear generally proves less terrible upon close acquaintance.

Mr. Wordingham opposes the idea of independent stations for tramway systems. I still maintain that when municipalities come to supply private industries with cheap energy for lighting and power purposes, the central stations in large manufacturing centres will require to constitute an independent department for the generating of electricity for such purposes, and that separate stations will need to exist for the generating of power for the tramway systems, otherwise the whole business will become unwieldy.

I am quite in accordance with Mr. Wordingham's views that it would involve an entire article in itself to deal thoroughly with the question of a station supplying mixed demands, and a tramway system generating its own energy, and I feel certain that an article on this subject from Mr. Wordingham would be highly appreciated by all interested in this question.

If the tramway system were worked as a separate concern, generating its own power, it could be made to work to its utmost earning capacity, and there would be very little plant standing idle. This is a vital point affecting both light, power and tramway systems, and I venture to suggest that it demands consideration from chiefs of central station plants generating current for manufacturing concerns and for lighting purposes; the main reason why manufacturers have had to put down their own generating plants at considerable expense when only a stone's throw from the central station supply may be said to be due to the apathy hitherto shown by municipal management in tapping this lucrative source of income.

It is interesting to note the comments relating to the traction load not showing a steady demand on the station for 15 to 18 hours. This is really one of the main reasons why the writer advocates that in order to maintain a constant load the tramway systems should adopt any reasonable scheme to carry goods and light parcels during the hours at which the load is likely to fall off.

T. W. Sheffield.

Heat and Temperature.

I thought I should not be compelled to trouble you again. My first letter of a month ago was in answer to what I felt to be a not very brave attack upon myself, which I could only resent as being hurtful to students. Mr. Swinburne said that entropy is not a factor of heat corresponding to temperature (this is untrue); that it is a function which essentially concerns the reservoir (this is untrue); that the $\theta\,\phi$ diagram does not give the same area as the $p\,v$ diagram (if he means by $\theta\,\phi$ and $p\,v$ diagrams what I mean, this is untrue); that the definition of entropy which he found fault with was given not only in engineering text-books, but in nine out of ten treatises on mathematical physics (perfectly true, and true if he includes Clausius and all other good writers on thermo-dynamics—certainly true as to several of my books, and I have been the means of introducing it in all evening science classes). After all this, it was unnecessary for him to say, "Most writers define entropy incorrectly," "The mathematical physicist then generally, perhaps consciously, rises to accuracy, but sometimes he does not"; "Unfortunately, also, entropy fell among pedagogues" (like the man of the Scriptures who travelled to Jericho). I need not go on to his charges of our having a fellow feeling for inexactness. We are getting well accustomed to sneers at teachers by Mr. Swinburne and his satellites.

I walked softly, I answered him carefully, pointing out that what he was objecting to was the second law of thermo-dynamics. I cannot add to that answer of mine, nor take away from it, and I write now by compulsion. But I should like it to be known that if a man says that 2 and 3 do not make 5, and one blames him for it, it is really impossible to avoid what in a discussion would seem to be personal abuse. Of course, there is no discussion and no personal abuse in these letters of mine. On the contrary, I have gone leagues out of my way to avoid giving abuse.

I cannot *discuss* Mr. Swinburne's letters and articles, because he uses terms that look like mathematical expressions, which happen not to be mathematical expressions. When any correct person speaks of the heat $d\text{H}$ being given to stuff which is at the temperature θ, he means what he says. When Mr. Swinburne uses $d\text{H}/\theta$ he means different things by his $d\text{H}$ and his θ in different parts of the same letter or article or sentence. In his last letter to you he says, "Prof. Perry says there is a quantity which is now called entropy which I will for the moment call x, such that $dx = d\text{H}/\theta$ in an irreversible change. . . . ." There is no mathematical person who reads what I have written who will agree with Mr. Swinburne that I ever made such a ridiculous statement. Read my statement and then say, What is θ in an irreversible change when the temperatures of different parts of the stuff are different? Surely Mr. Swinburne knows that the characteristic of an irreversible change is that θ has no meaning! It would be rude in me to quote here what Tennyson said about Bulwer Lytton in his "New Timon" attitude, but I should very much like to. What does Mr. Swinburne himself say that he means by θ when the stuff is not all at the same temperature?

To track him down was as difficult as for Hiawatha to

get at Paupukeewis, and in my anger I happened most unfortunately to say in my last letter to you "that Clausius uses a term. . . . ." I might have known that Mr. Swinburne would take this "term" in a wrong sense. Now, I never said that there was any departure in modern books from the reasoning advanced by Clausius or from his very careful and exact definition of entropy. His definition of entropy and statements about it are all in perfect agreement with the statement made in my first letter to you. I was, of course, referring to the term $\frac{dQ}{T}$ used by Clausius in his most important memoir called the ninth in his collected papers, where, in pp. 328—9 (translation by Hirst), he says, "By dQ we understand an element of heat absorbed, and T shall be the temperature counted from the absolute zero which the body has at the moment of absorption, or if different parts of the body have different temperatures, the temperature of the part which absorbs the heat element, dQ." There is a note to this; he refers to his fourth memoir, explaining how he had changed the sign of dQ, "then the thermal element given up by a changing body to a reservoir of heat is reckoned positive. An element withdrawn from a reservoir of heat is reckoned negative." Now, I have no wish to refer to the change of sign of dQ, although as we know, it was historically important to Clerk Maxwell, but I do wish to point out (1) that without this note Mr. Swinburne could not speak of dQ or T having anything at all to do with a heat reservoir, and, therefore, that I am trying to do my best to get some support for him; (2) that dQ is assumed to be received by an element of a changing body (whose temperature T may differ from that of the other elements, and T is certainly not the temperature of the reservoir in such a case) not from other elements of the body, but an outside reservoir. Here is a very exact definition of the term dQ/T, and everybody knows that Clausius was absolutely exact and correct in the use he made of it. But I know of nobody—not even Mr. Swinburne, who uses this term in the Clausius-sense, although he uses Clausius's results and expressions in other senses, evidently thinking them the same. As I take it, Mr. Swinburne *mainly* speaks of the heat leaving the reservoir, the reservoir being at the stated temperature. If he would use this always, I could follow him, but when he speaks of irreversible changes taking place in the stuff which engineers deal with in a cylinder, he may mean the heat from the cylinder metal or the steam jacket, or he may mean the heat that I always mean—the heat received by an element of the stuff from any source whatsoever including other elements—and as to temperature he may mean by temperature of his source or reservoir the temperature of one part of the metal, or another part, or his steam jacket. The men he attacks use mathematical expressions correctly—he uses what only seem to be mathematical expressions.

Am I very tedious? I am trying to be exact. He uses the expressions of Clausius as if they contradicted what modern writers have said, whereas there is no departure from the reasoning of Clausius in modern books. For although when we use dH/θ, we do not mean exactly what Clausius meant by his dQ/T, our reasoning in thermodynamics is the same as his; our definition of entropy is exactly the same as his.

So far as I know, the only time that Clausius ever spoke of the entropy of a body whose parts differed in temperature (and when any philosopher speaks of a body undergoing an irreversible operation he means that, during the operation, its temperature is different in its different parts), he uses the idea which we should all use now. He did not there need to speak of $\int\frac{dQ}{T}$ in the sense in which he employed it elsewhere, as having anything to do with entropy, because, in this case, his $\int\frac{dQ}{T}$ is certainly 0, as there is no outside reservoir. But imagining his changing system to be at any instant divided into an infinite number of elements, in each of which the temperature is known, say, θ, and imagining that an element receives the heat dH, no matter from what source, he would say that this element receives the entropy $\frac{dH}{\theta}$, and the sum of all the entropies of all the elements is the whole entropy. I take it that this is the only way of dealing with the entropy in an irreversible operation of the whole stuff (of course it need not always be regarded as an irreversible operation of an *element* of the stuff). I cannot see any other way of looking at the statement made by him at the end of that ninth memoir of his—it is perfectly consistent with all that he has written, with all that modern writers except Mr. Swinburne have written. His statement at the end of his reasoning is "The entropy of the universe tends to a maximum."

Mr. Swinburne says "Entropy is not a factor of heat corresponding to temperature,"—he is certainly wrong if he means by heat the heat entering the stuff, and if he means by temperature the temperature of the stuff. Of course it is impossible to say whether he is wrong or right in what he would call his reasoning until he defines his terms. But when he says that "Entropy is a function which essentially concerns the reservoirs," he is using the word entropy in a sense in which it is not to be found used by Clausius except in the one case in which it happens that the stuff is at the temperature of the reservoirs—that is, really, in not one case at all.

The entropy of stuff (and neither Clausius nor anyone else that I know of, except Mr. Swinburne, ever spoke of the entropy of anything but the stuff) depends in no sense on the temperature of the reservoirs from which its heat came; it depends on the state of the stuff itself.

I suppose that if all the stuff is not in the same state, we may imagine it divided into elements in each of which we *may* speak of the entropy. But in no case has it anything to do with the reservoir.

To say that the entropy of some stuff with which I am dealing depends on the temperature of any or all the reservoirs of heat from which it obtained some of the heat existing in it—depends on the temperature of the sun, for example—is surely unphilosophical.

Gentlemen, I am afraid I have wearied your readers. This is the sort of thing from which I refrained in my first letter, but it has been demanded from me by the extraordinary letter of last week. I hold by what I said in that first letter and by all that I have written. But as I once said when entangled in controversy with a man who maintained that the earth was flat, there must be some limit even to a flat one-sided controversy.

By the bye, it is well to let students know that when, in the $\theta\,\phi$ diagram of which Mr. Willans was so fond,* we indicate release at the end of the stroke by assuming that the stuff is cooled at constant volume in the cylinder itself, we get such an exact representation of what occurs that the heat area agrees, not merely to a few per cent., as my students have found by trial, but absolutely exactly to the area of the $p\,v$ diagram.

John Perry.

Royal College of Science,
February 2nd, 1903.

Pupin's Telephone System.

Mr. W. Moon has stumbled and fallen by assuming "A" to be a constant independent of "l."

"A" is a very complex function to evaluate, if the electrical values of the apparatus at the sending end are all included, but in its simplest form it contains a factor

$$\left(e^{2\beta l}+e^{-2\beta l}-2\cos 2\alpha l\right)^{-\frac{1}{2}}.$$

The Translator of the Article.

LEGAL.

Rosling & Fynn, Ltd., v The Law Guarantee and Trust Society, Ltd., and Others.

In the Chancery Division of the High Court of Justice on Thursday last week, Mr. Justice Buckley again had before him the case in which the voluntary liquidator of Rosling & Fynn claimed an

* It was the great belief of Mr. Willans in the usefulness of the Macfarlane Gray diagram which first caused me to employ it.

interim injunction to restrain the Law Guarantee and Trust Society and Messrs. Rhodes, Fielding & Halford from carrying into effect a contract for the sale of the company's property at Bradford to the second defendants for the sum of £10,500.

His Lordship the previous day had granted an interim injunction provisionally restraining the sale.

Mr. Cave, counsel for the plaintiff, now stated that the parties had all come to terms. It was desired to put an end to the action upon the terms of the settlement arrived at between the parties. They were all *sui juris*, and it was not necessary to state the terms of the settlement to the Court.

His Lordship: Then all you want is an order staying further proceedings in the action.

Mr. Cave: Yes.

His Lordship made the order as asked.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Feb. 4th, 1902.		Week ending Feb. 3rd, 1903.	
Adelaide	Value £100	Alexandria	Value £25
Amsterdam	65	Amsterdam	87
Batavia. Teleg. mat.	45	Bilbao	26
Calcutta	940	Bombay	134
Cape Town	483	Brisbane	67
Channel Islands	100	Buenos Ayres	153
Colombo	55	,, Teleg. mat. ..	761
Copenhagen. Teleg. wire ..	173	Calcutta	2,360
Durban	398	,, Teleg. cable	194
East London	273	Cape Town	785
Fremantle	337	Colombo. Teleg. mat.	88
Hamburg	77	Durban	2,660
Havre. Teleg. mat.	65	,, Teleg. mat.	1,353
Madras	200	East London	375
Port Said	50	Fiji. Teleg. mat.	331
Santos	43	Flushing	300
Shanghai	200	Gibraltar. Teleg wire	224
Stockholm	119	,, Teleph. cable ..	113
,, Teleg. mat.	195	Melbourne	250
Sydney	3,167	North Atlantic. Teleg. cable ..	1,260
Wellington. Teleg. mat. ..	385	Perth	136
,, Teleph. mat. ..	246	Port Elizabeth	168
Yokohama	25	Reval. Teleg. cable	300
		Rotterdam	7
		Singapore	62
		Sydney	70
		Syra. Teleg. mat.	53
		Wellington	190
		Yokohama	214
		,, Teleg. cable ..	694
Total ..	£7,741	Total ..	£13,473

Foreign Goods Transhipped.

Boston. Elec. mat. ..	Value £52
Boulogne. Elec. goods	52
Calcutta. Elec. mat.	93
Total ..	£197

Mica in 1902.—Messrs. Tulloch & Co., of 4, Fenchurch Avenue, E.C., have sent us a copy of their annual trade report regarding mica. Last year, it is said, was in the main, an unsatisfactory one for importers, and probably also not a prosperous one for mica distributors and manufacturers. During the first six months demand was mostly hand to mouth, but lessening imports and the gradual reduction of stocks of useful qualities and sizes, especially of electrical mica, has during the last few months assisted a more active demand, mainly for Madras. The general outlook for the present year is more hopeful, although the large increase in the use of micanite and similar compressed mica insulation materials must, it is thought, further reduce the consumption of the larger sized slabs. For medium sizes the prospects are more cheerful. The imports for 1902 were, on the whole, lighter, as the following figures will show:—

1901—11,095 cases. 1902—9,193 cases.

Deliveries to the trade from public warehouse were approximately:—January—December, 1902, 13,114 cases, as compared with about 10,865 cases January—December, 1901.

Central Station Condensing Plant.—The Mirrlees Watson Co., Ltd., of Glasgow, inform us that they have at present in hand, or in course of completion, condensing plant for the following electrical stations:—Pemberton, Stretford, Glasgow Corporation Lighting, Bristol, Merthyr Tydvil, Stalybridge, Leicester, Croydon, Bendigo (Western Australia), Bournemouth and Poole, North Metropolitan Tramways, and Aston Manor, in addition to plant for several private firms.

Fire Prevention.—The British Uralite Co., Ltd., of 50, Cannon Street, has placed in our hands a report of a recent fire test carried out by it at West Kensington. We have already stated in detail the excellent advantages possessed by Uralite for fireproof building construction, and the necessity for adopting this or some other similar material, especially for temporary buildings, has been very painfully and forcibly driven home by the Colney Hatch disaster. The test referred to was carried out in December last as follows:—Paraffin-soaked wood was piled inside a Uralite hut, and subjected to fires giving a maximum temperature of 2,340° F. All who are specially interested in fireproof construction should apply to the company for a copy of this fully illustrated pamphlet.

Parliamentary Standing Order Proofs. — In the course of recent examinations of private Bills for proof of Standing Orders, the following, which contain clauses of electrical interest, were considered:—

Macclesfield and District Electric Tramway.—It was found that Standing Orders had not been complied with in respect of seven sections of the proposed tramways, and the matter will have to go before the Standing Orders Committee to decide whether they shall be suspended.

Metropolitan District Railway.—In this, which is one of two Bills being promoted by the Metropolitan District Railway, Standing Orders were found not to have been complied with, and the Bill will drop unless the Standing Orders Committee decides that it shall proceed.

Rochester, Chatham, Gravesend and Maidstone Tramways.—There was no appearance in the case of this Bill, which contained proposals for incorporating a company with a large capital, and for the construction of a considerable number of tramways in the County of Kent. The Bill was accordingly marked "dead."

London and Brighton Electric Express Railway.—This was the proposal for the construction of an electric railway on the monorail system at an expenditure of about £4,000,000. There was no appearance, and the Bill was marked "dead."

Tynemouth and District Electric Tramways (Extensions).—The agent was unable to satisfy the Examiner that Standing Orders had been complied with, and accordingly it will go before Standing Orders Committee.

South Staffordshire Tramways.—Proof of compliance could not be given, and the Bill will go before the Standing Orders Committee.

Manchester Southern Tramways (Lancashire).—The hearing was postponed till February 19th.

Harrow Road and Paddington Tramways.—Objection was taken by the Willesden Urban District Council against certain provisions, and the Examiner found that there had been a non-compliance with Standing Orders, and the Bill will accordingly have to go before the Standing Orders Committee.

Wigan Corporation Tramways.—It was held that Standing Orders had not been complied with in this Bill, and accordingly it will go before the Standing Orders Committee who will decide whether it shall be allowed to proceed.

London County Council (Tramways and Improvements).—There was opposition on Standing Orders to this Bill, and it was decided to adjourn it until February 6th.

Dewsbury, Batley, &c., Tramways.—The hearing of the proof in this Bill was postponed till February 6th.

Hove, Worthing and District.—Adjourned *sine die*, for counsel to confer with clients.

Chatham and District Light Railways Co. (Tramways, Tramroads and Electrical Power).—The consideration of this Bill, which was opposed, was postponed till February 23rd.

City and Crystal Palace Railway.—There was no appearance in this case, and consequently the Bill was struck out of the list as an abandoned Bill. The object of the Bill was to have incorporated a company with a capital of £3,450,000, to construct an electric tube railway from Cannon Street to the Crystal Palace.

Preston and Horwich Tramways.—The consideration of the proofs was postponed till March 2nd.

South Lancashire Tramways.—The hearing of this proof, which is opposed, was adjourned till February 6th.

Wakefield and District Tramways.—The consideration of this Bill was postponed.

Luton, Dunstable and District Tramways.—This Bill proposed to incorporate a company with a capital of £140,000, to lay down and maintain tramways in the County of Bedfordshire. There was no appearance, and the Bill was marked "dead."

South Lancashire Tramways Co.—The Leigh Corporation has deposited a memorial in the Private Bills Office alleging non-compliance with Standing Orders. It is claimed that the notice with regard to the proposed tramways in the borough of Leigh are insufficient; that the plans have not been deposited with the town clerk; and that the notices improperly describe tramways in the parishes of Hindley and Wigan.

Standing Orders were found to have been complied with in the following cases:—Cheshire Lines Committee; Nottinghamshire and Derbyshire Tramways; Stroud, District and Cheltenham Tramways; Exeter Corporation; Pontypridd U.D.C.; Kingston-upon-Hull Corporation; Leigh Corporation; West Cumberland Electric Tramways; S.E. & L.C. & D. Railways (electrification clauses); Coventry Electric Tramways; Erith Tramways and Improvements; Great Northern, Piccadilly and Brompton Railway (new lines and extensions); Wellingborough and District Tramroads; Dudley, Stourbridge and District Tramways; Clapham Junction and Marble Arch Railways (No. 1); Metropolitan District Railway (works); Birmingham Corporation; Beckenham U.D.C.; Wood Green U.D.C.; North-Western Electricity and Power Gas; Manchester Southern Tramways (Cheshire); L.C.C. (electric supply); London United Tramways; Manchester Corporation; Sutton Coldfield Corporation; G.N. and City Railway; Great Northern, Piccadilly and Brompton Railway (Various Powers); Belfast Street Tramways Co.; Newcastle-upon-Tyne Electric Supply Co. and Walker and Wallsend Union Gas Co.; City and South London Railway; Charing Cross, Euston and Hampstead Railway; Woolwich Borough Council; North-West London Railway; West Ham Corporation; Baker Street and Waterloo Railway (Transfer); Shropshire, Worcestershire and East Derbyshire Electric Power; Carmarthenshire Electric Power Co.; Antrim, Down, Armagh and Belfast Electric Power; Aston Manor Improvement; India-rubber, Gutta-percha

and Telegraph Works Co.; Somerset and District Electric Power; Stoke Newington Borough Council; Hastings Tramways; Seaforth and Sefton Junction Railway; Romford and District Tramways; Mid-Yorkshire Tramways.

Exhibition at Athens.—Messrs. Charles Atkins and Nisbet, of 1, Water Lane, Great Tower Street, E.C., who are the general agents and sole commissioners for the Royal International Exhibition which is to be held from April to October next at Athens, have sent us a copy of the prospectus relating to the show. Those of our readers who are interested in the matter can obtain copies of this document on application at the above address. It is thought that the present is a very favourable opportunity for pushing British trade in Greece, and as France, Germany and Italy are taking part in the exhibition, it is very desirable that British manufacturers should be well represented.

Bankruptcy Proceedings.—A receiving order having been made at the London Bankruptcy Court against George Calvert, electrical and motor-car engineer, 12, Woodville Road, Mildmay Park, and late of 487, Kingsland Road, N.E., the first meeting of creditors was held on Monday before Mr. C. A. Pope, Official Receiver. The debtor commenced business in July, 1901, with a capital of £60 of his own, and a similar amount borrowed from a friend. In July, 1902, he sold the business as a going concern to Calvert's Motor Co., Ltd., which was formed with a nominal capital of £5,000 to acquire it. As vendor, the debtor received 1,000 fully paid shares in the company, and was appointed as managing director at a weekly salary of £4, afterwards reduced to £3. He held that post until the company went into voluntary liquidation in the middle of December last, with Mr. Albert Pond (Pond & Co.), accountant, Coleman Street, E.C., as liquidator. The debtor attributes his insolvency to the failure of the company. He has filed accounts showing unsecured debts £230 7s.; contingent liabilities (taken over but not discharged by the company), £387 19s., and preferential claims, £25 0s. 6d., against assets £20, consisting of household furniture. The 1,000 Calvert's Motor Co. shares are also scheduled as an asset, but no value is attached to them. The deficiency is returned at £623 6s. 6d. Mr. J. Bannister Brown attended for the debtor, and no offer being submitted, the case was left in the hands of the Official Receiver to be wound up in bankruptcy. The public examination is fixed for February 25th.

At Hanley Bankruptcy Court on January 28th the public examination took place of John Frederick Worthington and Gerald Fairfax Nuttall (J. Worthington & Co., at Foundry Works, Foundry Street, Hanley, electrical engineers). The debtor's statement showed gross liabilities £1,272; assets £1,810 10s. 9d. Debtors attributed their failure to "losses on contract." Nuttall stated that the business was never really satisfactory from a financial point of view. It took a lot of capital in the first place to build up the business, and they always seemed to be in difficulties. They spent much money on a speciality—a small accessory, which was put on the market and went well. They ordered more parts, but had to wait 12 months before they could get them, and in the meantime they lost the market. Almost exactly the same thing happened on another occasion. On one contract in Manchester they lost about £200. Their work did not suit the consulting engineer, so they had to do it over again, through more or less a "fad" of his. The examination was adjourned till February 25th.

Books Received.—"Electrical Problems for Engineering Students," by W. L. Hooper and R. T. Wells. Boston, U.S.A., and London: Ginn & Co. 1902. 6s.

"L'Amiée Electrique," by Dr. F. de Courmelles. Paris: Ch. Béranger. 1903. Fr. 3.50.

Sale.—Messrs. Hands, Ltd., of 22, Garlick Hill, E.C., have a sale of electrical fittings, which they want cleared during the next three weeks. See our advertisement pages this week.

Dissolutions and Liquidations.—The Surprise Arc Lamp Syndicate is winding up voluntarily with Mr. F. Brown, of 1, High Street, Croydon, as liquidator.

A meeting of the Crompton-Howell Electrical Storage Co. is to be held on March 4th, to hear an account of the liquidation proceedings from Mr. R. H. Marsh, liquidator.

A dividend of 20s. in the £ is to be paid on February 5th in *re* the Electric Lamp Regenerating Co., Ltd., of Crown Court, Old Broad Street. It is payable at the Official Receiver's offices, 33, Carey Street, W.C.

Trade Announcements.—Messrs. Hands Bros. have commenced business at 34, Snow Hill, Holborn, E.C., as manufacturers of electrical fittings and accessories, and for the time being the management is in the hands of Mr. George Hands, late of Hands, Ltd.

The Diesel Engine Co., Ltd., have removed from 171, Queen Victoria Street, E.C., and have taken extensive offices at 179, Queen Victoria Street, so that they may be able to deal with the increasing demands for their engine. The Diesel engine is now made up to 1,000 B.H.P. for electric lighting and pumping stations and general factory purposes. The company has recently completed the erection of an engine at the Royal Dockyard, Portsmouth, and others are working in various parts of the country.

Messrs. Bradbury, Son & Co., Limited, steam coal contractors, of 14, Leadenhall St., E.C., are removing on Monday next, 9th inst., to larger premises at 23, 24 and 25, Billiter Street, E.C. The removal is made to meet increasing business.

The head office and stores of the Aberdeen electricity works have been removed from Cotton Street to Dee Village Works, Milburn Street, Aberdeen.

Calendars and Catalogues.—A neat little calendar has come to hand from Messrs. John D. Mackenzie & Co., electrical engineers, of Glasgow. A photograph is let in above the date slips, showing the Harviestoun Castle, Dollar, N.B., at which the firm recently installed a small turbine-driven set, and E.P.S. battery, Mr. R. F. Yorke being consulting engineer.

The Wm. Powell Co., of Cincinnati, O., has sent us a wall calendar for 1903, on the sheets of which are given some brief particulars of its steam engineering specialities.

An excellent catalogue has been produced by the Western Electric Co., of North Woolwich, in which particulars are set out in a very neat style, of their numerous telephone instruments and accessories. The first-class illustrations which appear of all kinds of telephonic apparatus, together with the general arrangement of the details, give the catalogue something of a superior "carriage," so to speak. Western Electric standard switchboards, wall switchboards, magneto wall and desk instruments, private installation sets, batteries, bells, switches, and a great variety of parts are particularised and shown, prices also being given. The book is well bound in stiff red covers.

A small leaflet of "Twencen" telephones for private installation work has been sent out by the Berliner Telephone Manufacturing Co.

ELECTRIC LIGHT AND POWER NOTES.

Antrim.—The County Council has decided to oppose the Bill of the Antrim, Down, Armagh and Belfast Power Bill on its introduction to Parliament next session.

Barnstaple.—The opening ceremony of the electrical undertaking took place on January 29th, the light being switched on by the Mayoress.

Beckenham.—The U.D.C. has decided to promote a Bill for the purpose of establishing electric light and tramways in its district.

Bedford.—The T.C. has decided to apply for a loan of £5,548 for extensions of the plant at the electricity works, and of £1,828 for the erection and equipment of a sub-station. The extensions to the plant comprise a large water-tube boiler to replace two small ones, £1,395; applying mechanical draught to five of the existing boilers, £360; a 500-KW. steam turbo-alternator, £3,793.

Birkenhead.—The Parliamentary Committee has recommended the T.C. to oppose the Bill promoted by the North-Western Electricity Co.

Blockley.—The Parish Committee has entered into an agreement with Mr. Spencer Flower to light the streets by means of 36 electric lamps.

Blackpool.—The Electricity Committee has decided that customers using motors shall have a reduction of 10 per cent. when their quarterly accounts come to over £25.

Bridlington.—The T.C. has adopted the plans submitted by Mr. Medhurst, consulting engineer, for an electric supply scheme covering the whole of the compulsory area.

Brixworth.—A representative of the Northampton Electric Light and Power Co., Ltd., attended the meeting of the R.D.C. on January 29th, relative to the company's application to the B. of T. for a prov. order to supply electricity within the parishes of Moulton, Moulton Park, Church Brampton and Chapel Brampton. It was stated that the company would supply energy for motive purposes. The Council unanimously assented to the application.

Caerphilly.—Seven objections have been lodged against the application of the U.D.C. for a provisional order to supply electricity. The objectors are the Rhymney Railway Co., the Taff Vale Railway Co., the Barry Railway Co., Cardiff T.C., Rhymney and Aber Gas Co., Lord Windsor, and the Cardiff Steam Coal Co.

Carnoustie (N.B.).—The T.C. has approved of a proposal by Messrs. Crompton & Co., Ltd., that a flat rate of 6d. per unit be fixed for the electric light.

Cardiff.—An old church has been secured by the Great Western Railway Co., and is now being rapidly converted into an electric power station, the spire being utilised as a stack. The company intends lighting its premises from the Cardiff passenger station to that of Roath, and the work is approaching completion. Mr. F. Newton is the resident engineer.

Cheltenham.—The poll respecting the proposal of the T.C. to promote a Bill for the extension of the electric lighting undertaking and other matters has resulted unfavourably. Against the Bill 5,904 votes were registered, and in favour only 2,555.

Chorley.—The B. of T. has informed the T.C. that the question of revoking the Chorley Electric Lighting Order, 1898, will be deferred for a year.

Croydon.—The Corporation has decided to spend £200 in the construction of a concrete subway at the generating station, through which it is proposed to lay all the main cables. This work

will be carried out in connection with the reinstatement following the recent fire. An insurance claim amounting to £3,000 has been made to cover the damage then done.

Doncaster.—The borough electrical engineer in his monthly report stated that the number of applications received since December 1st, 1902, to present date were 10, being equivalent to 607 8-c.p. lamps; number of consumers on books, 242; number of 8-c.p. lamps applied for up to present date, 16,501; number of 8-c.p. lamps connected, 15,865; number of 8-c.p. lamps awaiting connection, 636; number of consumers awaiting connections, five.

Dowlais.—The Dowlais Steel and Iron Works have added a third generating set to their power plant, the building having been enlarged for that purpose.

Dublin.—The plant of the old electric light station having been offered for sale in consequence of the opening of the new station at Ringsend, the tenders of Mr. Thomas Ward, Albion Works, Sheffield, and Mr. John Frame, Talbot Place, Dublin, have been accepted, subject to the sanction of the Lighting Committee.

Dungannon.—An inquiry was held by Mr. P. C. Cowan, M.Inst.C.E., Chief Engineering Inspector of the Local Government Board, with reference to an application by the Dungannon Urban Council to the Local Government Board for their sanction to a loan of £6,000 for the purpose of lighting the town by electricity. It is proposed to instal a Dowson gas plant, with Westinghouse engines and generators, and 72 public lamps.

Eastry.—The R.D.C. has decided to oppose the application of the Kent Electric Power Syndicate for a prov. order, in conjunction with other authorities.

Evesham.—The T.C. has appointed a Committee to consider the question of electric lighting for the town.

Exeter.—The net profit for the year of the electric light undertaking is £1,500, and brings the accumulated profits to over £5,000.

Glasgow.—In connection with the new dock which the Clyde Navigation Trustees are erecting at Clydebank, a joint subcommittee has been appointed to report to the Committee of Management as to the motive power for the hoists and cranes to be provided at the dock.

The Trustees have granted permission to Messrs. John Nisbet and Co., to erect and work an electric crane at the berth recently allocated to them at Custom House Quay.

Gravesend.—The T.C. has under consideration the extension of the electric lighting mains along Old Road East at an estimated cost, including a street lighting cable, of £650.

Hebden Bridge.—The U.D.C. has refused the offer of Halifax Corporation to supply energy at 1½d. per unit from 6 a.m. to 4 p.m., and at 2½d. per unit outside those hours. On January 28th the Council resolved to carry out its own scheme at an estimated cost of £10,260.

Kingston.—The Lighting Committee has informed the London United Tramways Co. that it disagrees with the proposals of the company for supplying electrical power in the borough. A reply has been received with a copy of the Tramway Co.'s Bill, 1903, Clause 15 whereof proposes to authorise the company to make agreements for the supply of electrical power in Kingston.

Lancaster.—On Tuesday last Mr. H. Percy Boulnois, C.E., held a L.G.B. inquiry into an application by the Corporation to borrow £25,000 for electric lighting purposes. £70,000 has now been expended in capital on the electricity works, which were constructed in 1894. Sanction had been previously obtained for £60,000, but there was £3,092 over-spent. It was explained by the electrical engineer, Mr. W. A. Tester, and Mr. Councillor J. Heald (chairman of the Electricity Committee), that the sum of £35,000 was really required, but a proportion of £10,000 had received Parliamentary sanction under the Bill of 1900, which authorises the tramway scheme of £70,000. When the tramway scheme was in preparation, the Electricity Committee decided to change the pressure from 100 volts to 230 volts, purchasing plant which would be available for either traction or lighting purposes. The cost of the extensions and plant was £34,986, made up as follows:—£3,092 over-spent upon previous extension; £5,035, power station buildings; £23,000, cost of generating plant and other machinery; £1,500, cost of changing to the higher pressure; £2,071, extension of the mains; and £288, extension of arc lamps.

Liverpool.—The Electric Power and Lighting Committee estimates that it will spend during the current year on capital account, for the supply of electricity, £223,724. The liabilities of the Committee now amount to £1,482,427, which comprises—loans, £1,155,149; creditors, £61,021; surplus and sinking fund, £193,741; due to bank, £72,514. The city electrical engineer reports an increased output during 1902 for light and power of 17 per cent., and for tramways 15 per cent. as compared with 1901. The equivalent in 16-c.p. lamps was 220,924, as compared with 180,990 in 1901; 827 motors were in use, representing 2,877 h.p., compared with 587, of 2,083 h.p., in 1901. The output for the year was 23,186,086 units, of which 15,890,579 units were supplied to the tramways. The engineer drew attention to the rapidly-increasing demand for energy for power purposes, and mentioned the necessity for considering at an early date a scheme for the future development of the undertaking.

London.—City.—The Corporation having been in negotiation with the City of London Electric Lighting Co. and the Charing Cross and Strand Electricity Co. with regard to the charges to be made for lighting the Guildhall and other Corporation buildings, has decided to enter into an arrangement with the City of London Electric Lighting Co. for the supply of electrical energy at 3½d. per unit, and 2½d. per unit for power, and 5 per cent. discount on monthly settlement of accounts, subject to the company agreeing to allow the rate of 3½d. to apply to all outstanding accounts of the City Lands Co., and to the arrangement being determinable by three months' notice.

Hackney.—The Hackney Borough Council is prepared to instal shilling-in-the-slot pre-payment meters free of charge to any present or prospective consumer whose installation does not exceed 80 8-c.p. lamps. The charge for the electricity used through these meters is at the rate of 4½d. per unit, which sum includes the rent of the meter.

Edmonton.—At a meeting held on January 30th last in the Town Hall, a resolution was adopted calling upon the D.C. to at once carry out its powers for electric lighting in the district.

Hammersmith.—The Borough Council has decided to obtain an additional feed pump at an estimated cost of £205.

Electric Light Legislation.—Borough Councils are being asked to approve the London County Council Electric Supply Bill, whose object is to obtain further powers with respect to the purchase of electric undertakings in the County of London by the local authorities. The Battersea Borough Council is endeavouring to obtain a clause enabling a local authority to amalgamate its undertaking with those of adjoining authorities, and, with the consent of the local authority, to supply within the area of the adjoining local authorities.

Lytham.—A meeting has been held to consider the expediency of carrying out the provisions of the Lytham electric lighting order. There appears to be a majority against the resolution, but a second resolution was adopted appointing a committee of ratepayers to consider with the Council the best methods of providing an electrical supply in Lytham.

Manchester.—The Electricity Committee has decided to recommend the reduction of the price of energy for motive purposes from March 25th next from 1¾d. to 1½d. per unit to consumers using their demand for 48 hours and upwards per week, and from 3d. to 2½d. per unit to shorter-hour consumers.

The T.C. has been recommended by the Electricity Committee to apply for a loan of £160,000 for electricity purposes, and a further loan of £200,000 for tramway purposes.

Newport (Mon.).—The new power station is approaching completion; the engines are now undergoing trial runs. The amount set forth in the Corporation financial estimate for the year for expenditure on the electricity undertaking is £12,564, an increase over last year of £4,493, but as against this the estimated revenue is placed at £22,726, last year's actual receipts being only £13,616. For the electric tramways £15,744 will be required, instead of £12,325, the amount expended last year, when the receipts were £13,616, and for the coming year, calculated, no doubt, upon a big increase of traffic through the opening of new branches, the receipts are estimated to produce £22,726.

Norwich.—The T.C. recommends that an Electricity Committee be appointed to take over the powers vested in the Council under the Norwich Corporation (Electricity, &c.) Act, 1902, for the management and control of the undertaking of the Norwich Electricity Co., Ltd., when transferred to the Corporation.

Pateley Bridge.—The U.D.C. is negotiating with two companies with the object of introducing the electric light into the town.

Pembroke (Dublin).—The Electrical Works Committee claims to have reduced its coal bill by 50 per cent. by the use of Schmidt's patent superheaters.

Peterborough.—The Corporation is proceeding energetically with its street lighting, and has given the gas company notice to remove their standards in the centre of the town.

Reigate.—Owing to the great increase in the demand for electricity, the T.C. has instructed the electrical engineer to prepare plans, &c., for the extension of the works. It is proposed to instal an additional 200-kw. alternator.

The T.C. has decided to pay £25 per year each for all-night electric arc lamps.

St. Andrew's (N.B.).—Messrs. Crompton & Co.'s proposal that a flat price of 6d. per unit be charged for the use of electric light has been adopted by the T.C.

South Staffordshire Mines.—The first practical and definite step in the electrical scheme for dealing with the surface water in the South Staffordshire Mines Drainage Commissioners' area has just been taken, the first electric pump having been delivered, and the Commissioners have entered into an agreement with the Midland Electric Corporation for Power Distribution, Ltd., as to a surface drainage pumping station at Ocker Hill.

Southend-on-Sea.—The T.C. has adopted alternative rates for the supply of electricity to tradesmen—viz., 6d. and 3d. per unit on the maximum demand system, or a fixed charge of £6 10s. per annum per kilowatt demanded, with an addition of 1½d. per unit consumed. Private consumers are to have the option of a uniform flat rate of 4½d per unit.

Spain.—The Fortuna Mining Co., of Mazarron, Spain, has just placed a contract for a complete electric power plant. It will comprise Piedbœuf boilers, two 250-H.P. Swiderski engines, coupled to Schuckert dynamos, and Sulzer high-pressure centrifugal pumps.

Stoke-on-Trent.—The T.C. has decided not to oppose the preamble of the North-Western Electricity Company's Bill. A sub-committee will consider the provisions of the Bill and report thereon.

Sunderland.—The Electricity Committee has had under consideration its power scheme for supplying energy to local shipyards and works, and has signed extensive contracts with Sir W. T. Doxford & Sons, Ltd., shipbuilders, and the North-Eastern Marine Engineering Co., Ltd. The extensions will necessitate the construction of two additional sub-stations.

Swinton and Pendlebury.—The Lancashire Electric Power Supply Co. has offered to enter into an agreement with the U.D.C. to supply electricity in bulk on or before January 1st, 1904. The offer has been referred to the Electricity Sub-Committee.

Tipton.—Major Cardew, the arbitrator appointed to consider the agreement between the U.D.C. and the Midland Electric Corporation with reference to the electric lighting difficulty, in his award states that he has decided that, according to the true intent and meaning of the agreement, the expression, "Supply of electrical energy in bulk to the Council for private lighting purposes," was intended by the parties subscribing thereto to apply to and include the supply of electrical energy through distributing mains and connections with consumers laid down and maintained by the company, as well as the supply furnished through mains laid by the Council. He also decided that at the time of the signing of the agreement 3d. per unit was a fair price for energy supplied through the company's mains, and that 2·6d. per unit was a fair price for energy supplied through mains laid down by the Council.

Walton-on-Naze.—The U.D.C. has granted the Coast Development Co. an extension of time until March 25th next for the completion of the electric lighting scheme, on condition that the company agrees to pay £2 per week for any subsequent extension.

Warrington.—The Electricity and Tramways Committee of the Warrington T.C. has recommended the Council to apply to the L.G.B. for sanction to borrow £20,000 for extensions to generating plant.

Wednesbury.—The T.C. has appointed Mr. Warden-Stevens as consulting engineer for the electric lighting scheme at 5 per cent. on the outlay.

Wellington (Salop).—The U.D.C. on Thursday decided to oppose the Shropshire, Worcestershire and East Derby Electric Power Co.'s Bills, with the object of securing a clause excluding its district, except with the consent of the Council. It was also decided to approach the company with reference to a supply of electricity to the Council.

ELECTRIC TRACTION NOTES.

Baltimore, U.S.A.—The United Railways Co. has made over the entire control of the electric traction and electric lighting system in Baltimore to the Mount Washington Electric Lighting Co. for the sum of $2,000,000. This transaction is part of a scheme to utilise the water-power of the Susquehanna River and transmit electrical energy to Baltimore, Philadelphia and Wilmington.

Batley.—The negotiations between the B.E.T. Co. and the Corporation with respect to the running of electric tramways in the borough have been broken off, and it is said the Corporation will now proceed on independent lines. Negotiations have been proceeding between the company and the Corporation for some months, and it was announced a short time ago that terms had been arranged, and that the Corporation would complete all the lines within its area, equip them for electric traction and then lease them to the company. The deadlock appears to have arisen in connection with the expenses incurred by the Corporation in opposing the company's application in the first instance for powers to construct lines in the borough. These costs are reported to have amounted to £1,500, and the company undertook to pay them. The company admits this, but declines to pay until the new Bill has passed. The Corporation, on the other hand, holds out for payment before the agreement is signed. It is said that the Corporation, rather than give way, will pursue an independent policy, and it is also stated that it will be ready for running cars in the summer. It is erecting electricity works for both lighting and traction purposes, and these are nearing completion.

Berlin Elevated.—Numerous experiments, so far unsuccessful, have been made with a view to discovering some method of reducing the noise due to the trains on the Berlin Electric Elevated Railway. In one case a length of 100 metres was laid with a layer of felt between the rails and the sleepers, but the reduction of the noise thereby was insignificant. In another case hollow iron sleepers filled with sand were tried. This method had, on a small scale, given good results, but in actual practice on the elevated railway proved of little use. In other cases the substitution of longitudinal for cross sleepers has been tried, as has also the introduction of a lead sole-plate between the rail and the sleepers. Still another plan under test is the filling in of the car wheels with wood. The problem is, however, still unsolved.—*Engineering.*

Cardiff.—As the result of a conference between the Corporation and the Tramways Co. held on Friday last, an offer of £23,500 by the former to purchase the three tramway depôts was accepted, thus avoiding arbitration. In the first instance the company asked £28,000, and the T.C. offered £22,000.

Chicago.—The promoters of the Chicago electrical traction scheme, in which Mr. J. P. Morgan is largely interested, have offered valuable concessions to the city, on the condition of its consolidating the elevated roads and establishing a uniform fare. The company proposes to spend $25,000,000 in the improvement and extension of existing lines.

Crewe.—The T.C. is in negotiation with a Manchester firm of electrical engineers with a view to the adoption of an electric tramways scheme. The T.C. proposes to supply energy for working the cars, and to have the lines laid through the borough. The Crewe lines will also be connected by a trunk line with Nantwich.

Croydon.—The R.D.C. will support the Bill which the B.E.T. Co. is about to promote in Parliament, authorising the construction of electric tramways in the parishes of Beddington and Wallington. In order to obtain the support of the Council, the company had to agree to the following conditions:—The company to lay along the route of the proposed tramway a single line on one side of the road with lop-sided loops, in such a manner that when a double line is constructed the said loops will form part of such double line; the company to provide a double line throughout the Council's district at the request of the Council, but not earlier than five years from the date of the Royal Assent, but the company, if it so elect, may do so earlier; the company to make all roads along the tram route 50 ft. wide, to make other minor improvements, and to make a payment to the Council of £2,000 for the purposes of highway improvements.

Doncaster.—Col. Boughey held an inquiry here on January 27th respecting an application of the Corporation for tramway extensions to cost £15,000.

Dover.—The Light Railways Commissioners have submitted to the B. of T., for confirmation, two orders relating to light railways in Dover and district.

Dunedin (N.Z.).—The City Council has adopted Messrs. Browne & Stewart's scheme of conveying water from the Lee stream, by means of a tunnel and pipe line, to the power house for generating electricity for the city tramways.

Glasgow.—The proposal by the T.C. to utilise the tramway rails and trolleys for the removal of refuse in the main thoroughfares of the city during the night for quietness to the citizens and the quick despatch of the refuse has in the meantime been dropped. Another proposal to utilise the tramway electric power for driving an electrical sweeper during the night has also been deferred for a time.

The Corporation is considering a proposal to extend its electric car system from the terminus at Kilbowie Road to Duntocher, a distance of about 1½ miles.

Gloucester.—The T.C. has adopted the overhead trolley system and a gauge of 3½ ft. for the tramways.

Huddersfield.—Next Wednesday the chairman of the Tramways Committee will start the new generating set at the power station at Longroyd Bridge, and subsequently luncheon will be served at the Town Hall.

Lancaster.—The T.C. has fixed the price for energy to the new electric tramways at 2d. per unit.

Leigh.—The T.C. has decided to oppose the Bill of the South Lancashire Tramways Co. on the ground that the plans deposited do not properly illustrate the proposed lines in Leigh and Hindley, and that the publishing of notices was not properly carried out.

L.B. and S.C. Railway.—At the L.B. and S.C. meeting, presided over by Lord Cottesloe on 28th ult., after referring to the financial results of the year, it was stated that there was an increase of £4,208 during the year in law and Parliamentary charges incurred in opposing various electrical schemes which were threatened in the company's districts last session, but that those schemes were all defeated, and that two others, threatened for this year—namely, Mr. Behr's scheme for constructing a mono-rail line between London and Brighton, and a tube railway, which was projected from the City to the Crystal Palace—had already disappeared from amongst several which it was feared would have to be opposed in the company's interests.

Ilford.—It is stated that a Bill to connect Ilford and Romford by electric tramway is being promoted by the Empire E.L. & P. Co.

London Railways and Electric Traction.—From present appearances, the popularity of tube schemes and electrically-operated railways generally, promises to be as great during the coming session of Parliament as on previous occasions. Whether this popularity is equally shared by the promoters of the schemes and the travelling public, only time will show; but at least those unfortunates who patronise the Metropolitan District lines under present overcrowded conditions at busy hours, will assuredly hail with delight any proposed means of alleviation; the latter, also, will have no cause for complaint on the score of ventilation in certain of the suburban sections, which will be built in the open. This applies to the suburban half of the City and North-East Suburban Railway, and to the Watford and Edgware Railway, which is entirely of open construction. The latter railway will form a continuous route with the Edgware and Hampstead and Charing Cross and Hampstead Railways authorised in a previous session, thus giving a through route from Charing Cross to Watford. The Bills deposited by the Baker Street and Charing Cross and Hampstead Companies propose no new works, but seek to transfer their undertakings to the Great Northern and Brompton Co. The combined undertakings will in future be known as the Underground Consolidated Electric Railways Co.

The following table, compiled by the *Pall Mall Gazette*, gives a list of all the Bills which it is intended to introduce in the coming Parliamentary session; it also contains particulars of their proposed lengths, estimated cost, and the capital powers sought in each case, the totals amounting to over £25,000,000:—

	Length. Miles.	Estimated cost.	Capital.
Baker Street and Waterloo Rly. (Transfer)	—	—	—
Central London Railway (new lines)	9	£3,223,478	£4,200,000
Charing Cross, Euston, and Hampstead Rly.	—	—	—
City and North-East Suburban Electric Rly.	22¼	4,217,033	6,000,000
City and South London Railway	1½	519,212	800,000
Clapham Junction and Marble Arch Railway (No. 1)	4½	1,768,656	2,720,000
Clapham Junction and Marble Arch Railway (No. 2)	4½	1,384,231	2,000,000
Great Northern and City Railway	—	—	—
Great Northern Railway	¼	69,500	—
Great Northern, Piccadilly and Brompton Railway (new lines and extensions) ..	6	2,343,178	3,200,000
Great Northern, Piccadilly and Brompton Railway (various powers)	—	—	333,000
London, Tilbury and Southend Railway ..	½	297,600	800,000
Metropolitan District Rly. (various powers)	2	615,153	1,200,000
Metropolitan District Railway (works) ..	8¾	1,853,789	2,800,000
North-West London Railway (extension) ..	1½	519,038	933,000
Watford and Edgware Railway	6½	279,564	400,000
Totals	62¼	£17,120,452	£25,386,000

In the above list it will be noted that the Great Northern and City Co.'s Bill provides for a re-arrangement of capital only; the Central London, City and North-East Suburban, City and South London, and the Clapham Junction and Marble Arch Railways, seek to revive their proposals of the previous session. With reference to the last-named railway, it will be noted that two competing schemes are proposed.

The Great Northern and Brompton Co. seek to revive the proposed alternative route to Hammersmith which was proposed last year, but modify certain details.

The Metropolitan District Co. propose several short connecting lines with the object of facilitating an interchange of traffic with adjacent lines, and the North-West London Co. propose an extension of their present authorised route (from the Marble Arch to Victoria Station), so as to provide a continuous route to Cricklewood.

Lowestoft.—Mr. J. F. Albright has accepted the offer of the T.C. of £605 for the purchase of the powers of the Drake and Gorham Electric Power and Traction Syndicate for the construction of a light railway at Kessingland.

Mersey Railway.—On Friday last current from the new generating machinery at the Shore Road station, Birkenhead, was for a time fed into the railway circuit. Nine Stirling water-tube boilers are now installed. They will be fed from overhead bunkers, these bunkers being supplied by an elevator, which raises the coal from a crushing house, in which it is reduced to a suitable size. Three generators of 1,200 KW. each, and two of 400 KW., all direct coupled to compound engines, have been installed by the Westinghouse Co. A 36 ft. switchboard has been constructed of marble slabs. The cables have been laid from the board to a tunnel used for drainage, and they pass along this tunnel to a ventilating shaft, down which they have been carried to the lines. The cars have been received and are now ready for use. They have been manufactured by Messrs. G. F. Milnes & Co. The coupling will be automatic, following an initial movement of a lever by the driver or attendant. The cars are of five types, and the trains will consist of two or three motor-cars with or without trailers. Each motor-car has four (approximately) 100 H.P. Westinghouse motors. The motor-cars weigh some 30 tons, and the trailers about 18 tons.

To cultivate a larger parcel traffic on the electrified line, an arrangement has been come to by the Mersey and Wirral Railway Companies under which parcels will be carried by both lines at rates which are about one-half of the rates lately in operation. Quick and frequent terminal deliveries have also been arranged for.

Manchester.—The Corporation Tramways Committee has recommended the following appointments and increases of salary in the department:—Mr. J. J. M'Mahon, electrical engineer, from £250 to £300; Mr. J. T. Oakes, traffic superintendent, from £300 to £350; Mr. H. Mattinson, assistant permanent way engineer, from £210 to £235; Mr. D. G. Mallalieu, permanent way superintendent, from £200 to £225; Mr. Jas. Wood, accountant at £300, to be financial superintendent at £325; Mr. F. A. Mitcheson, assistant accountant at £200, to be accountant at £250; Mr. G. M. Macdonald, cashier at £140, to be chief cashier at £200.

Newcastle-on-Tyne.—The interim report of the professional auditor of the Corporation (Mr. T. Bowden) has just been issued for the half year from March 26th to September 29th last. According to this the electric tramways revenue was as follows:—Balance on March 25th, £2,234 19s 5d.; traffic receipts, £72,972 16s. 4d., and other small items, making a gross total of £76,729 4s. 9d. The gross payments were £54,918 19s. 7d., which included interest on loans, £9,317 17s. 2d., and repayment of loans, £4,477 14s. 2d., thus leaving a balance on September 29th of £21,810 5s. 2d. This being an interim credit no account was taken of outstanding liabilities for traffic expenses, maintenance, interest and the repayments of loans, to which the above balance is subject.

The tramway manager recently reported to the Tramway Committee that Mr. Harry Richardson, of the power station, had been appointed electrical engineer at Dundee, and he proposed to divide that gentleman's work between Mr. Claughton and Mr. Dalton, each to receive a salary of £200. It was decided to try the suggestion for a period of six months.

The T.C. has decided to oppose the Bill promoted by the Tyneside Electric Tramway Co., for powers to lay down electricity mains through certain streets in the city.

Peterborough.—The electric tram service was inaugurated on the 24th ult., following the official inspection by the Board of Trade on the previous day. One route was opened, 11,000 passengers being carried in the first 10 hours. Another section was opened on the 31st ult.

Salford.—The Tramways Committee has recommended the T.C. to promote a Bill in the ensuing Parliamentary session authorising the extension of the tramways, the conveyance of goods, powers to run on the lines in Stretford, and authority to require the owners and lessees of the Stretford tramways to reconstruct and equip them for electrical traction and to supply current, in default the Corporation to carry out the work.

The Town Council has decided to apply to the Board of Trade for sanction to borrow £2,208 to meet the cost of the overhead equipment of the Whitefield tramways, and for £4,488 for the overhead equipment of the Bury New Road line.

Stoke-on-Trent.—The T.C. is considering the plans and proposals of the B.E.T. Co. for the proposed tramway to Newcastle-under-Lyne *vid* Hartshill. The company will be invited to consider various road improvements with the object of providing for a double track.

Taff Vale.—The report of the Taff Vale Railway Co. for the half-year ended December 31st last states that a Bill has been deposited to authorise the company to work traffic by electric power.

TELEGRAPH AND TELEPHONE NOTES.

Wireless Telegraphy.—A Montreal Press dispatch says that the secretary of McGill University College, writing to the Press, opposes the establishment of a wireless telegraphy station on Mount Royal in the following terms:—"The physical laboratories are continuously and extensively used for teaching the curriculum of the University, the subjects taught in them being not only an essential part of the University course, but also of fundamental necessity in training men for all branches of engineering and practical science. The operation on Mount Royal of a wireless telegraphy station would seriously impair the usefulness of the physical aboratories and would prevent the University from effectively carrying on in them the work for which they were especially designed and equipped. In addition to this injury to the teaching work of the University, the operation of a wireless telegraphy station in Montreal or in its vicinity would increase the danger of fires arising from defective insulation of electric wires of all kinds throughout the city, and might, therefore, increase to the University, in common with all the citizens of Montreal, the cost of insurance against fire."

The French Wireless Telegraphy Co. has asked the Under-Secretary of State for Posts and Telegraphs to authorise the establishment in the Isle of St. Pierre, off Newfoundland, of a long-distance wireless telegraphy station, which would permit of communication with the station established at Cape de la Hague, permission to reopen which has already been asked for.

(*Continued on page* 231.)

ELECTRIC OMNIBUSES IN ITALY.

On the occasion of the recent Exhibition of Modern Decorative Art at Turin, the first electric omnibus seen in Italy was exhibited by the Societa Alta Italia.

The advantages of omnibuses over tramcars are easily understood, as follows:—The absence of rails reduces the cost of the service to about one-third that of a tramway service; the ordinary vehicular traffic of the street is not interfered with; and no alteration or modification in the construction of the road is essential.

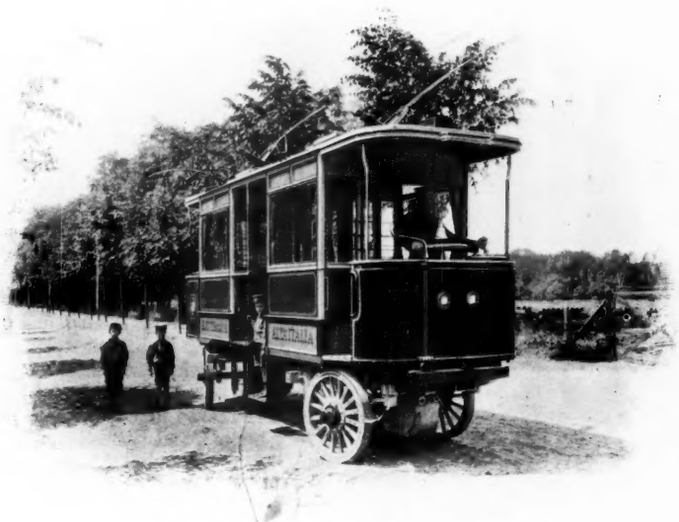


Fig. 1.—Electric Omnibus without Rails.

In Italy, where the abundance of hydraulic power promises a great extension of electric traction, the electric omnibus is eminently suitable, especially for communication between communes and villages of little importance.

With a system of electric omnibuses two overhead trolley wires are employed, one being used as the return. The omnibus at the Turin Exhibition, which we illustrate in fig. 1, was made by Messrs. Siemens & Halske, of Berlin, whose work in the direction of trackless electric locomotion has already been dealt with in our columns (see Electrical Review, Sept. 5th, 1902, p. 384). The omnibus consists of two bogies each with two wheels, on which rests the framework; each bogie is fitted, by the aid of a spring suspension, with a Siemens and Halske motor of the usual tramway type. This motor works the axles by the aid of a transmitting apparatus (Grisson's patent), which gives a maximum efficiency of 93 per cent., a much greater value than that obtained by the ordinary toothed wheels. The two axles are movable, and are connected by two cross ties. This arrangement gives the vehicle a considerable degree of mobility, enabling it to turn aside from its normal path to the extent of 3·50 metres on either side. Moreover, it greatly simplifies the manipulation, which is effected by a single driver-conductor, as shown in fig. 1. Fig. 2 shows the omnibus turning aside to avoid a cart.

The poles used for conveying the 500-volt current from the wires to the omnibus are very light, and are provided at their extremities with skates, which prevent deviations even when the omnibus turns aside suddenly to avoid other vehicles or pedestrians. Each platform is fitted with the usual manipulating, regulating, and brake apparatus; there is also a little wheel which controls simultaneously the two axles (connected together as stated). The omnibus is fitted with electric light, signal lamps, electric brakes, lightning conductor, &c.

The omnibus, which can draw another behind it, is divided into three compartments, two of which are closed, each capable of seating seven persons, and one in the centre, where the passengers enter, is open. Between this central compartment and the rear platform there is standing room for eight persons. Thus the omnibus is capable of accommodating altogether 22 passengers. It weighs 4,500 kg., whereas a tramcar weighs, on an average, 10,000 kg., or more than double. At Turin, experiments have been made with the object of comparing the starting and running resistance of the omnibus with that of a tramcar weighing 10,000 kg. running on rails. A horse was harnessed first to the omnibus, and then to the tramcar, the tractive effort being noted by means of a dynamometer. The following are the results obtained:—

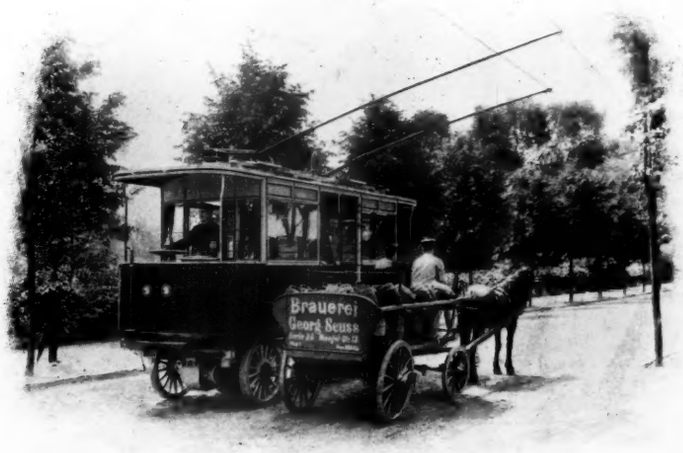
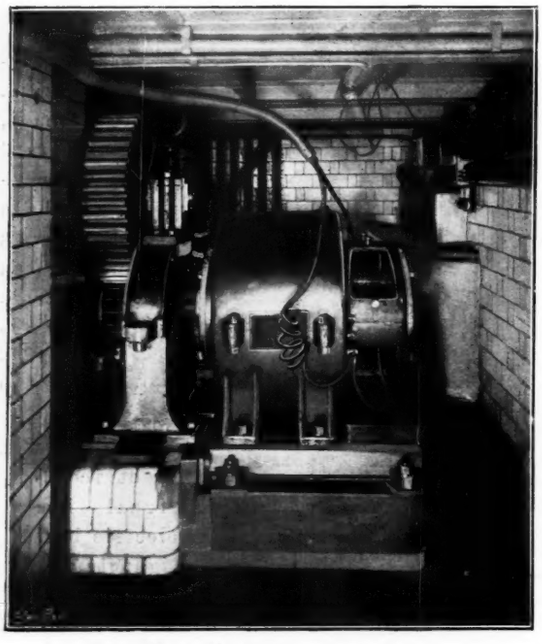


Fig. 2.—Electric Omnibus avoiding a Cart.

	Omnibus, 4,500 kg.	Tramcar, 10,000 kg.
Starting effort	400 to 500 kg.	500 kg.
Normal effort	—	180 to 210 kg.
Tractive effort on a good road	250 kg. (mean).	—
Tractive effort on a bad road	500 kg. (maximum).	—

THE "WARD-LEONARD" SYSTEM OF ELECTRICALLY OPERATING PRINTING MACHINERY.

The "Ward-Leonard" system of driving printing machinery, which is extensively used in the United States, has



50-H.P. Motor in Basement.

been introduced for the first time in this country for working one of the large machines in the offices of Messrs. Edward Lloyd, Ltd., the proprietors of *Lloyd's Weekly*, *Daily Chronicle*, &c., where a 62-H.P. equipment has been operating a sextuple Hoe press for some 18 months in regular practical work. Before forming their decision Messrs. Lloyd carefully examined the various systems available for driving printing presses, and after a very exhaustive study of the question both in this and other countries, adopted the "Ward-Leonard" system.

The following advantages are claimed for this system of control:—

The press can be brought from a state of rest to full speed, by imperceptible increments of speed, in the shortest time without risk of tearing the paper.

The press can be started or stopped without jars or shocks, and can be made to crawl round at low speeds for long periods.

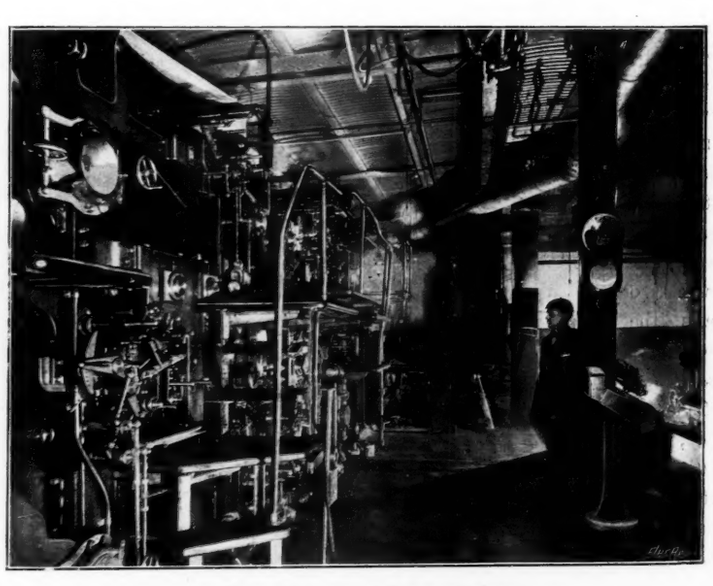
The loss of power due to speed regulation is never more than 2 per cent., even at creeping speed, plus the small loss in the motor-generator, which has been found by experience at Messrs. Lloyd's to be very small.

The press is absolutely under control at all speeds, and if it is set to run at a definite speed and the load alters, the speed still remains constant.

The last consideration is one of considerable importance, for it is well known that the load on the printing machine varies from time to time according to the condition of the rolls and the ink, the pressure on the paper, the thickness of the blankets and the time the machine has been in operation, &c. With the series rheostat system, as the load varies, so the current varies, and as the current varies, so the controlling effect of the rheostat and the voltage at the motor alters. On the other hand, with the "Ward-Leonard" system the voltage applied to the motor is independent of the load; in fact, the voltage is the same, no matter what the load may be within the limits of the machine; consequently the speed of the printing machine remains constant, notwithstanding these changes in the load, and whether the machine is running light or heavily loaded.

Generally speaking, the system consists in delivering the electricity to the press motor at a voltage suited to the precise speed at which the motor is running. For this purpose it is necessary to have a generator with a rheostat in its field circuit for varying the voltage. This generator may be driven by another motor, or by any external source, while it may generate the whole of the electrical power required, or, as in the case of Messrs. Edward Lloyd, Ltd., only one-half thereof. Here the generator is only half the size of the press motor, and it is driven by another motor which is also about half that size.

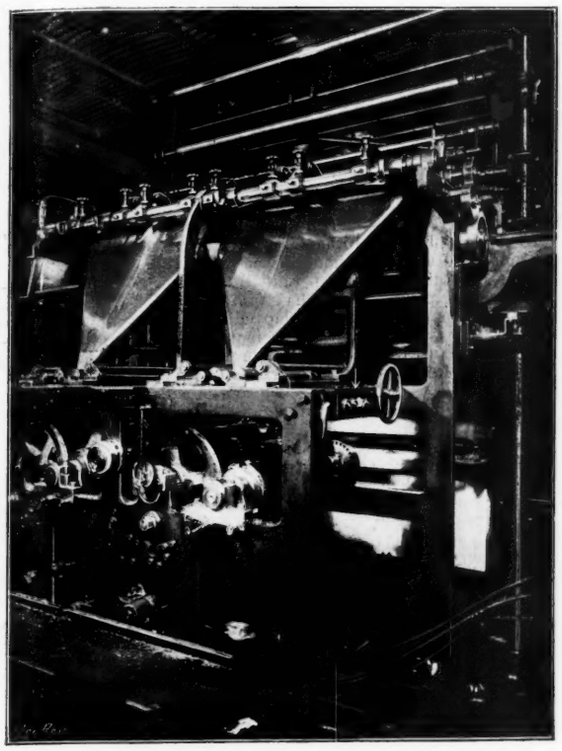
The arrangement is shown in diagram B (p. 229), where A B is a motor-generator, of which A is the motor and B is the generator, of 25 H.P.; the armatures of both are wound for 200 volts. E is the press motor of 50 H.P., the armature of which is wound for 400 volts. C and F are the fields of the generator and press motor respectively. Both of these fields are separately excited, and C has a reversible rheostat in circuit with it, having a large number of contacts. It will be seen that the current supplied from the line to the armature of E passes through the armature of B, which runs continually at full speed. When starting up, the field C is fully excited, and the voltage of the armature is equal to that of the line, but in a counter direction. Consequently, no current passes through E. The switch of the rheostat is now moved in a clockwise direction, inserting a small resistance in field C, so that the armature voltage is slightly reduced below that of the line. A current sufficient for the full torque then passes through E and the motor begins to turn slowly. To increase the speed, more resistance is gradually inserted until there is no magnetism remaining in field C; the motor E then runs at half speed, the voltage being that of the line. By still further moving the switch of the rheostat in a clockwise direction, the field C is reversed and gradually strengthened. The voltage of the armature B is now gradually increased in a direction which assists the voltage of the supply mains, and as soon as the whole of the resistance is switched



View of Press, showing Position of Controller.

out, double the voltage of the supply mains is applied to the motor, E, which then attains its full speed. The switch is then in the position shown in the diagram. It will be seen that as the controller has only to regulate the field current, it may be of very small size and yet have a very large number of contacts, thus affording a very gradual control, and securing freedom from that destructive sparking at the contacts which is so common with rheostats carrying large currents. Further,

the space occupied by this controller is but a small fraction of that required by the rheostats used on the series control system. The controller pillar is seen in one of our illustrations on p. 228, near the press.



The black arrow indicates the "creeping switch"; the white arrow shows the four push-buttons.

Front View of Press.

The loss in the motor-generator has been ascertained by Messrs. Edward Lloyd, Ltd., to be but small, while the loss in the controller varies from 0 at half speed up to the maximum of only 2 per cent. at low speed or full speed. The machine can be reversed if desired, but in the case of Hoe presses it is only necessary that this reversal should be applied at low speeds. For this purpose it is provided that the motor-generator is capable of giving a voltage slightly in excess of that of the line, so that when it is in opposition to the line this excess causes a flow of current through the armature, E, which then rotates in a reverse direction.

The flexibility of this system is well illustrated by the three "creeping switches" which are placed round the machine at different points. These switches have seven or eight steps in parallel with the early steps of the controller,

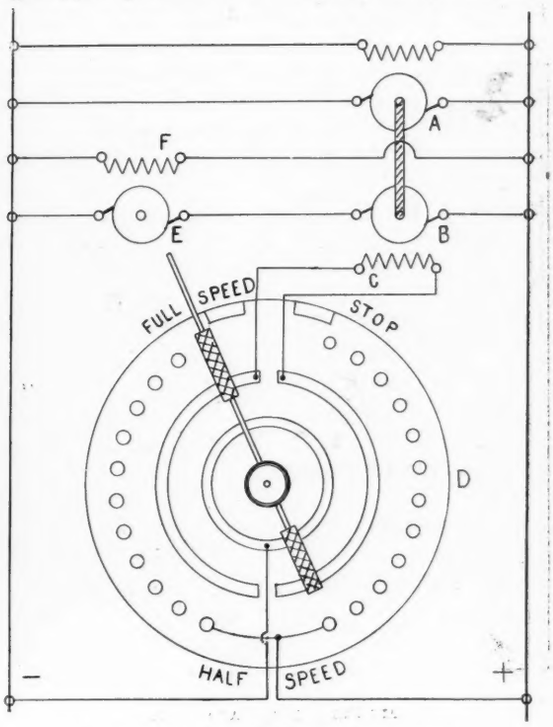
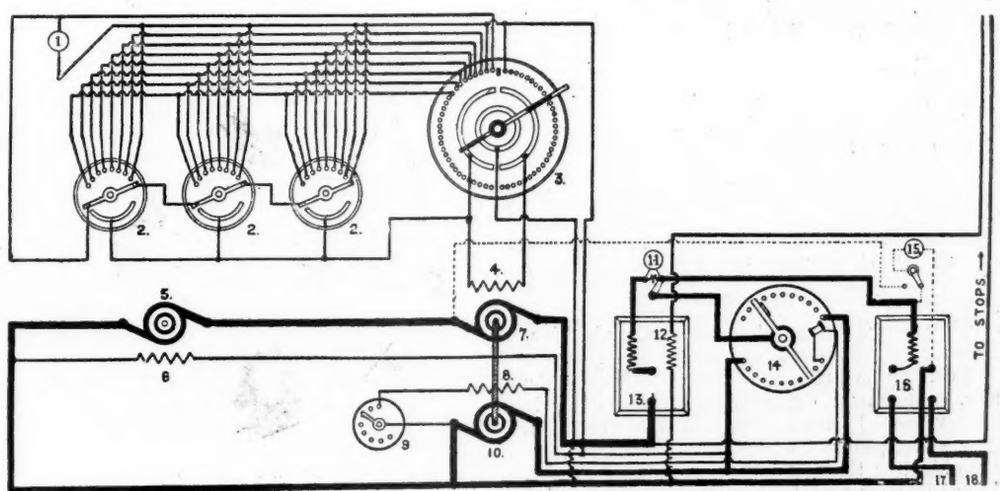


Diagram B.—Connections of Controller.

so that the machine-minders may themselves operate the press at the low speeds required for fixing the plates and threading the paper before the actual process of printing begins. The connections of these switches are shown in diagram A, below.

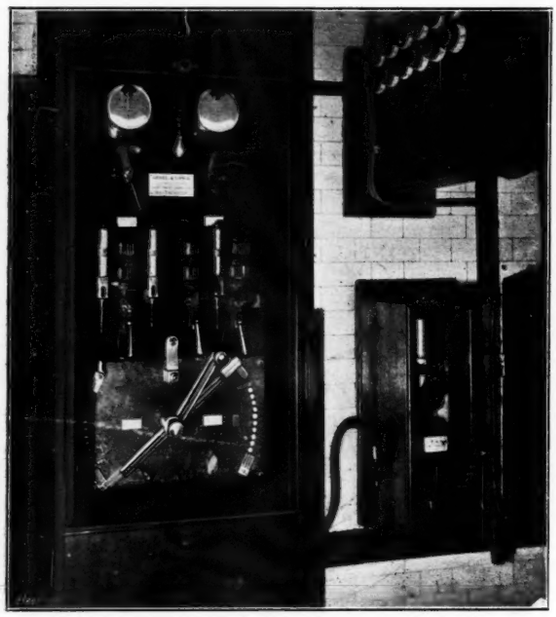
On the invitation of Messrs. Geipel & Lange, we paid a visit to the installation last week, and saw the press running at various speeds, as well as "creeping" and "inching round." The simplicity of the apparatus and the ease of control were particularly striking. The whole of the regulation of speed and direction of rotation is effected by the small controller; there is only one hand-wheel to work, which effects the whole of the operations in sequence, so



1, Single-pole switch; 2, Creeping switches (for low speed); 3, Field reversing and regulating switch; 4, Booster reversible field coils; 5, Motor for driving machinery; 6, Motor field coils; 7, Booster; 8, Booster motor field coils; 9, Field regulating switch; 10, Motor for driving booster; 11, Ammeter and switch; 12, Emergency tripping coil; 13, Single-pole circuit breaker; 14, Starting switch for motor; 15, Voltmeter and switch; 16, Double-pole circuit breaker; 17, Positive supply main; 18, Negative supply main.

Diagram A.—General Arrangement of Connections.

that it is impossible, even for an inexpert attendant, to make any mistake. The controller is carried on a pedestal, which is fixed to the floor near the machine, in the most convenient place; the main switchboard, which carries the measuring instruments, &c., is fixed on the wall some distance off, out of the way, for it is not necessary for the attendants to use this board in operating the machine.



Main Switchboard and Meter.

The system possesses an additional advantage which appeals more particularly to the central station engineer, in that, instead of drawing the full current from the mains at starting up, which causes unsteadiness of the supply voltage, the current required from the mains at starting is but a fraction of the full load current, and that fraction is switched on gradually.

It may be of interest to add the following description of the signalling apparatus and switchboard arrangements, which, however, do not form a necessary part of the "Ward-Leonard" system. In order to signal to the attendant who operates the controller, a bell and indicator having three different coloured lights are fixed near the controller, which are operated by pushes fixed at various points round the machine. The colours represent "start," "full speed" and "stop," while the bell calls attention to a change in the signals. The colour of the light remains constant until another signal is sent.

In case it is necessary, in emergency, to stop the machine instantly, a circuit-breaker is provided, which is operated by pushes placed round the machine alongside the pushes for signalling, so that the circuit may be automatically opened by pressing any one of these pushes, which instantly stops the machine.

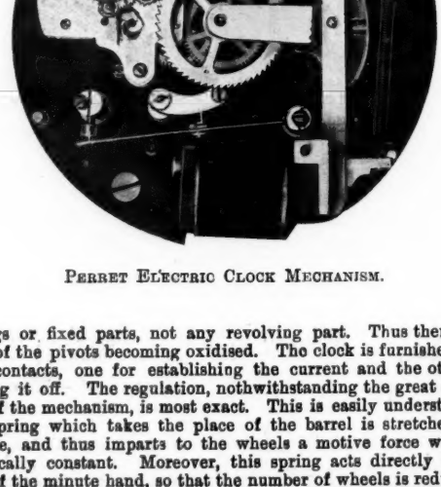
The switchboard is of enamelled slate, mounted with a motor starter for the motor-generator, an ammeter having a two-way switch, by which means the current supplied to the press motor, or the total current taken from the supply mains respectively can be measured, and a voltmeter with a two-way key which permits the voltage at which the press motor is working, or the voltage of the mains to be read. "Ward-Leonard" circuit breakers take the place of switches and fuses, so that should an excess of current due to a jam in the press open the circuit, it can be quickly closed again when required, thus saving the loss of time due to replacing the ordinary fuse, an important consideration in the production of a newspaper.

The energy used is metered by a Vulcan watt-hour meter, which not only integrates the energy used on the usual dials, but also registers the rate at which it is used on a chart. Thus measurements can be readily made both of the power and of the energy used. A roller shutter protects the switchboard from dust and grit when the press is not working.

The Hoe press is of the sextuple type, and prints, when driven at full speed, 60,000 copies per hour of *Lloyd's Weekly News*, having 24 pages. The whole installation was carried out by Messrs. Geipel & Lange, of Parliament Mansions, Westminster, who are sole lisensees for the system.

The Ruthenberg Electric Furnace.—We learn from Mr. Orrin Dunlap, of Niagara Falls, that "at the works of the Cowles Electric Smelting and Aluminium in West Lockport, N.Y., on Thursday, January 15th, Marcus Ruthenberg, of Philadelphia, Pa., made a demonstration of his new process for manufacturing steel. Mr. Ruthenberg was permitted to erect one of his new furnaces in the plant, and he had invited to be present several gentlemen representing the independent steel operators of the United States. The claim is made that by the use of the Ruthenberg electric furnace the intermediate processes of making pig-iron, oxidisation, &c., are eliminated or practically combined in the one operation, and that from the raw material fine steel is turned out ready for the market. In speaking of the process, Mr. Ruthenberg said it was not improbable that the independent operators might use it as a weapon to fight the great steel trust. According to the inventor electricity is, by his process, applied to the smelting of iron ore at about half the cost of the reduction of ore through the blast furnace and steel hearth. The furnace tested that day was unique in that it used only about $\frac{1}{10}$th the power formerly used in reducing iron electrically, thus putting it upon a very favourable basis of comparison with the ordinary methods of the blast furnace and steel hearth. The raw ore is first cleaned to the highest degree of purity, reducing material in the form of charcoal or coke dust is incorporated with the ore, and then it is fed to the electric furnace, producing a reduced fused mass which goes to the open hearth furnace as steel melting stock, saving the ore from going through the blast furnace. This economises 33 per cent. of the fuel and all of the limestone, and at the same time produces a better and purer quality of steel."

The Perret Electric Clocks.—We learn from a Continental contributor that Mr. David Perret's electric clock is making a considerable sensation in Switzerland just now. This clock, which is shown in the accompanying figure, presents the valuable feature of being wound automatically. One or two dry batteries start it and supply once a minute a feeble current lasting about $\frac{1}{30}$th of a second. Consequently the consumption of energy is exceedingly small. The duration of these batteries depends on their dimensions. The normal type is warranted by the inventor to work for three years. The electric mechanism is so contrived that the electric current does not pass into any part of the clockwork mechanism, properly so-called; it only passes through



Perret Electric Clock Mechanism.

springs or fixed parts, not any revolving part. Thus there is no fear of the pivots becoming oxidised. The clock is furnished with two contacts, one for establishing the current and the other for cutting it off. The regulation, nothwithstanding the great simplicity of the mechanism, is most exact. This is easily understood, as the spring which takes the place of the barrel is stretched each minute, and thus imparts to the wheels a motive force which is practically constant. Moreover, this spring acts directly on the axle of the minute hand, so that the number of wheels is reduced to a minimum and no part is subjected to strong pressure. The Perret electric clock is admirably suited to post and telegraph offices, railway stations, theatres, barracks, colleges, &c.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 226.)

Barrow Telephones.—In his report to the T.C., Mr. Bennett shows a large prospective profit on the proposed municipal telephone exchange. He estimates that with 480 possible subscribers a service can be provided at £5 17s. 6d. each, as compared with £7 10s. charged by the National Co.

Brighton Telephones.—The Postmaster-General is to be asked to extend the time for installing the telephone system from two years to three.

Cable Steamer "Patrol."—This vessel, built and engined by Messrs. Wigham, Richardson & Co., Ltd., to the order of the Eastern Extension, Australasia and China Telegraph Co., Ltd., has just completed her trials, attaining a speed of 15 knots on a long continuous run. We understand from a northern contemporary that the *Patrol* is a steel twin-screw steamer driven by triple-expansion engines, 370 ft. in length × 44 ft. beam, and is fitted with both fore and aft raising and paying-out gear.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1900	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
St. Lucia-St. Vincent	Nov. 18, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902	
Cadiz-Teneriff	Nov. 3, 1902	
St. Jacques-Haiiphong	Jan. 3, 1903	
Falmouth-Bilbao	Dec. 18, 1902	
Jamaica-Colon	Dec. 31, 1902	
Sitvebondo-Bandjermasin	Jan. 26, 1903	
Marseilles-Barcelona	Jan. 28, 1903	
Marseilles-Bone (both cables)	Feb. 3, 1903	
Landlines:—		
Route to Tientsin and Taku *via* Helampo	June 18, 1900	

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—March 10th. Tenders are being invited until March 10th by the Austrian State Railway authorities at Lemberg for the supply and erection of a complete plant for the electric lighting of the railway station at Lemberg. Tenders are to be sent to Die K. and K. Staatseisenbahn Direction, Lemberg, whence particulars may be obtained.

Belgium.—March 5th. Tenders are being invited until March 5th by the municipal authorities of Ghent, for the concession for the electric lighting of the town. Tenders are to be sent to L'Hotel de Vil e, Ghent, whence particulars may be obtained.

Bexhill.—February 21st. 300-KW. steam dynamo, water-tube boiler, superheater and crane. See "Official Notices" to-day.

Bulawayo.—February 26th. Establishment and working of an electric tramway. See "Official Notices" Nov. 21st.

Burnley.—February 23rd. Cables for lighting and tramway extensions. See "Official Notices" to-day.

Colchester.—February 17th. Condensing plant and air and circulating pumps. See "Official Notices" January 30th.

Darlington.—February 13th. Lancashire boiler, piping, feed-heater, traction feeders, permanent way construction, &c. See "Official Notices" January 16th.

Edinburgh.—February 16th. Electric light fittings for Colinton Mains Hospital. See "Official Notices" January 23rd.

Exeter.—February 19th. Doulton conduits, and two-phase feeder cables, for electricity supply. See "Official Notices" January 30th.

Exeter.—The City Council is to invite tenders for wiring the slaughterhouses for electric lighting purposes.

Germany.—February 18th. The State Mining authorities at Königsberg are inviting tenders until February 18th, for the supply of four electric travelling cranes and an electrically-operated turntable. Particulars may be obtained from, and tenders are to be sent to, Die Piefbauamt., Königsberg, Prussia.

Gt. Yarmouth.—February 17th. 300-KW. steam alternator. See "Official Notices" January 30th.

Guayaquil.—February 12th. The terms for the contract for lighting the city appeared in this column on January 2nd.

Hackney.—February 12th. 1,500-KW. steam dynamo and condenser, with electrically-driven pumps. See "Official Notices" January 9th.

Hammersmith.—February 11th. Electrical stores. See "Official Notices" January 30th.

Kingston-upon-Hull.—February 18th. Supply of al accessories, &c., for a complete telephone system. See "Officia Notices" January 30th.

Kingston-upon-Hull.—February 26th. Two Lancashire boilers, coal conveyor, stokers, &c., and fuel economiser. See "Official Notices" to-day.

Koloszvar (Austro-Hungary).—March 10th. The Municipal authorities of Koloszvar, Austro-Hungary, are prepared to consider tenders for the installation of an electric power station for the supply of motive power. Estimates are to be based on carrying out the enterprise at the expense and risk either of the town or of the would-be concessionnaires, and should be addressed to the municipality in question, at Matyaskiraly, No. 1, I. 5, Koloszvar.

Manchester.—February 14th. The Tramways Committee invites tenders for the supply of overhead equipment, tools, &c.

Oldham.—February 24th. The Electricity Committee wants tenders for the supply, delivery and erection of cooling towers, motor-driven centrifugal pumps, motors, and switchgear, pipework and overhead travelling crane, comprised in specification No. 10.

Southampton.—February 14th. The Ordnance Survey Dept. wants tenders for four 7½-B.H.P. motors, and four starting switches and resistances. See "Official Notices" January 23rd.

Southwark.—February 18th. Electric wiring for the New Town Hall extension. Specifications from the borough engineer, Vestry Hall, 81, Borough Road, S.E.

Sunderland.—February 27th. Surface condenser, induced draught fan, battery and booster, and piping. See "Officia Notices" to-day.

Swansea.—February 9th. Lighting new portion of workhouse. See "Official Notices" January 23rd.

Turkey.—The Turkish Post and Telegraph Authorities in Constantinople are inviting tenders for the supply of 60 tons of iron wire 4 mm. diameter, 20 tons of bronze wire 2 mm. diameter, and 27,000 porcelain insulators.

Warrington.—March 4th. Water-tube boilers and pipework, two 750-KW. steam dynamos, switchboard extensions. See "Official Notices" to-day.

West Ham.—February 10th. Electrical equipment of 8 miles of track. See "Official Notices" January 9th.

West Ham.—February 10th. Purifier, and re-erection of four Babcock boilers. See "Official Notices" January 23rd.

West Ham.—February 10th. Electrical supplies. See "Official Notices" January 30th.

CLOSED.

Bray.—Messrs. Johnson & Phillips have sub-let to Messrs. Browett, Lindley & Co., Ltd., the order for an engine to drive a 150-KW. alternator of their make for the Bray U.D.C., to Mr. R. Hammond's specification.

Brighton.—The T.C. has received the following tenders for the construction of the overhead equipment in London Road and Old Steine:—

British Electric Equipment Co., London	£1,224 6 6
Henley's Telegraph Works	1,316 14 1
Martin A. Shepstone & Co.	1,329 3 0
Estler Bros., London	1,493 15 2
British Thomson-Houston Co.	1,557 7 0
Lowden Bros., Dundee	1,579 8 3
J. G. White & Co., London	1,677 12 2
R. W. Blackwell & Co., London	1 961 11 11
G. Hill & Co., Manchester	2,014 19 4

The Committee recommends the Council to accept the tender of the British Electric Equipment Co., for the sum of £1,224 6s. 6d.

Cardiff.—The Tramways Committee has received tenders for 20 four-wheel double-deck cars from seven firms, and has accepted that of the British Thomson-Houston Co., Ltd., at £504 for each car, total £10,080. The cars are to be similar in design and finish to those now running. In the matter of purchasing single-deck combination bogie cars, Mr. Ellis, the electrical engineer, has been instructed to ascertain from the Thomson-Houston Co. the price of one such car.

Dewsbury.—Messrs. Dick, Kerr & Co. have sub-let an order with Willans & Robinson, Ltd., of Rugby, for a 260-H.P. engine for direct coupling to their dynamo, intended for supplying power to the new tramways at present being laid down by the B.E.T. Co.

Edinburgh.—The Edinburgh Corporation has decided to instal a 1,250-H.P. Willans engine for direct coupling to a Siemens dynamo.

France.—The French Post and Telegraph Authorities in Paris have just given out contracts as follows:—La Société Alsacienne de Constructions Mecaniques, of Belfort, 40 kilometres of telephone cable at 295 fr. per kilometre, and Messrs. Geoffrey and Delore, of Paris, 100 kilometres of double conductor telephone cable at 475 fr. per kilometre.

Glasgow.—Messrs. Crompton & Co.'s offer has been accepted by the Corporation for 125 arc lamps and 30,000 pairs of Conradty's best carbons. The price of the lamps is £6 1s. 6d. each; and for the carbons £140 12s. 6d.

Glasgow.—The sub-committee of the Glasgow Corporation appointed to deal with the matter has recommended that the offer of the British Westinghouse Electric Co. for the electric motor equipment for 100 cars be accepted. The amount is £17,529. The recommendation will come before the Town Council.

Halifax.—The T.C. on Monday accepted the tender of the Electrical Construction Co., of Wolverhampton, for a 750-KW. direct-current dynamo, coupled to a Pollit & Wigzell horizontal cross-compound engine, at £6,631.

London.—The London County Council has accepted the tender of the Clyde Structural Iron Co., Glasgow, for £1,228 17s. for the erection of a temporary iron car shed at the tramway depôt in Rye Lane.

Lowestoft.—The T.C. has accepted the tender of Messrs. Callender's Cable Co. for the supply of underground feeder cables and switch pillars at £3,324.

Lowestoft.—The T.C. on Monday accepted the tender of the British Westinghouse Co. for the supply of tramcars (with Milnes bodies) at £8,661, and a track sweeper at £740.

North-Eastern Railway.—We are officially informed by this company that as a result of the tenders recently received by the North-Eastern Railway, for the electrification of about 37 miles of double track near Newcastle-upon-Tyne, they have accepted the tenders of the following firms:—The British Thomson-Houston Co., Ltd.—Electric equipment of motor coaches and trailer coaches on the multiple unit system, and the laying of the third rail, bonding and low pressure feeders. The British Westinghouse Electric and Manufacturing Co., Ltd.—The supply and erection of high and low pressure switchboards, rotary converters, static transformers, and all sub-station equipment. Our local correspondent informs us that the amount of the first-named contract approximates to £150,000.

St. Annes-on-Sea.—The Council has accepted the following tenders:—Dick, Kerr & Co., for their dynamo and Willans engine; Tinker's, Ltd., for boilers; Ferranti, Ltd., for switchboard.

Wrexham.—The T.C. has accepted the tender of the Alphons Custodis Chimney Construction Co., for an additional chimney at the electricity works at a cost of £728.

Yorkshire.—The Denby Grange Colliery has decided to instal a dynamo made by Wilson Hartnell, of Leeds, for direct coupling to a standard Willans high-speed engine.

FORTHCOMING EVENTS.

Friday, February 6th.—At 8 p.m. Junior Institution of Engineers. Meeting at Westminster Palace Hotel. Paper on "Calorimetry," by Mr. W. G. Wernham.

Saturday, February 7th.—At 7.30 p.m. Glasgow Technical College Scientific Society, 38, Bath Street. Paper by Mr. F. J. Rowan, on "The Science of Steam Generation."

At 10.30 a.m. Institution of Electrical Engineers (Students' Section). Visit to Messrs. Johnson & Phillips's works.

Monday, February 9th.—At 7.30 p.m. Institution of Mechanical Engineers (Graduates' Association). Lecture by Dr. R. T. Glazebrook on "The National Physical Laboratory and Engineers."

At 8 p.m. Institute of Marine Engineers, 58, Romford Road, Stratford. Paper on "The Speed Regulation of Steam Engines, Stationary and Marine," by Mr. W. Welbury.

Tuesday, February 10th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Paper on "A Study of Some Electrical Phenomena by the Aid of Oscillograms," by Mr. M. B. Field.

Wednesday, February 11th.—At 8 p.m. Association of Engineers-in-Charge. St. Bride Foundation Institute. Discussion on "Engineering Topics," by Mr. W. C. C. Smith.

Thursday, February 12th.—At 8 p.m. Institution of Electrical Engineers (London). See "Notes" columns for announcement.

Friday, February 13th.—At 5 p.m. Physical Society. Annual general meeting at Burlington House.

At 2.30 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Electrical Power Storage Co.'s works, Millwall, E.

Saturday, February 14th.—At 7 p.m. Junior Institution of Engineers. Annual Dinner at Hotel Cecil.

Saturday, February 28th.—Annual Corps dinner of the Electrical Engineer Volunteers at the Trocadero Restaurant.

NOTES.

"Science Abstracts."—We are informed that *Science Abstracts* will in future be published in two sections. Section A will deal with physics, embracing light (including photography); heat; sound; electricity and magnetism; chemical physics and electro-chemistry; general physics; meteorology and terrestrial physics; physical astronomy. Section B embraces steam plant, gas and oil engines; automobiles; oil engine-driven ships and launches; balloons and airships; general electrical engineering (including industrial electro-chemistry); electric generators, motors and transformers; electrical distribution, traction and lighting; telegraphy and telephony. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication, and has elected Prof. E. H. Hall, of Harvard University, as its representative on the Publishing Committee. In consequence of this arrangement, Section A will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also co-operating with the Committee and taking special means to bring the publication to the notice of all its members.

Whether the new arrangement, by which only those members of the Institution who expressly desire it receive (and pay for) this publication, is likely to lead to good results we do not know; but we fear that this move must have made an alarming reduction in the circulation. The value of the publication is unquestioned—but how many of the recipients fully appreciated it? We would not go so far as to describe the little red books as "pearls," but we do know that some members, at least, are in the habit of consigning them to the W.P.B. unopened. It is a pity that the contents lag so far behind the times—an interval of six months between the appearance of the original and that of the abstract is not only quite unnecessary, but it is calculated to detract very seriously from the value of the work. In fact, we would rather see greater efficiency introduced into the conduct of the publication than further additions to the already lengthy list of subjects dealt with.

London Electrical Contractors' Association.—On Tuesday last, 3rd inst., the question of "Trade Competition" was discussed at a meeting of this Association held at the Restaurant Frascati. Mr. H. Marryat opened the discussion,

Proposed Electro-Chemical Society.—A meeting was held on the 4th inst. in the Faraday Club Rooms, St. Ermin's Hotel, with the object of founding a society for furthering the technical and scientific questions relating to the electro-chemical industry. Mr. J. Swinburne, who took the chair in the first instance, commented on the need of such a society. Mr. J. W. Swan, in formally proposing the formation of a society with the above objects, remarked on the promising state of the electro-chemical industry; Mr. Alexander Siemens seconded, and the resolution was carried unanimously. Mr. Swinburne then proposed the following gentlemen as members of the Council, and they were duly elected:—

President.—J. W. Swan, F.R.S.

Vice-Presidents.—Prof. A. Crum-Brown, M.D., D.Sc., F.R.S.; Lord Kelvin; Sir Oliver T. Lodge, D.Sc., F.R.S.; Ludwig Mond, Ph.D., F.R.S.; Lord Rayleigh, D.C.L., F.R.S.; Alexander Siemens, M.Inst.C.E.; J. Swinburne, Pres.I.E.E., M.Inst.C.E.

Council.—George Beilby; Bertram Blount; W. R. Cooper, M.A., B.Sc.; Sherard Cowper-Coles; F. G. Donnan, M.A., Ph.D.; Prof. A. K. Huntington; F. Mollwo Perkin, Ph.D.; W. S. Squire, Ph.D.; O. J. Steinhart, Ph.D.; A. J. Charleton; R. A. Lehfeldt, D.Sc.

Mr. Swan then took the chair, and in the course of a few remarks, expressed his thanks for the honour shown him. He considered it desirable to refer the question of a definite name for the Society to the Council. After passing the usual votes of thanks to those concerned in the initiatory efforts, a short discussion ensued as to the probable journal of the Society, and as to the feasibility of combining with any existing society, reference being made to contemporary American and German societies with similar objects.

The Fire Exhibition.—We learn that a meeting was held on Thursday last week under the chairmanship of Mr. James Swinburne, to organise the electrical section—comprising primarily fire calls and telegraphy and electrical safeguards—when the preliminary arrangements were decided upon. A circular will shortly be issued to the electrical trade setting forth the arrangements for the electrical group. In the meantime all applications and inquiries should be addressed to the Honorary Secretary, Electrical Section, International Fire Exhibition, Earl's Court.

American Automobile Exhibition.—A New York correspondent writes to us as follows:—"The annual exhibition of automobiles was opened at New York on January 17th at Madison Square, and shows an immense advance on that of last year. In no respect is improvement more evident than in the electrical side of the industry, a fair number of well-designed and reliable electrically-propelled vehicles being shown, some being made by manufacturers who hitherto have only sold motor-cars driven by other means. The automobiles vary from small cars specially designed as toys for children to wagons capable of hauling the heaviest merchandise, there being, for example, a trolley designed for a steel safe company, and fitted with an electric crane for loading and unloading. Electrical accessories were, of course, shown in large variety.

"The Baker Motor Vehicle Co., of Cleveland, Ohio, a firm which manufactures nothing but electromobiles, exhibited a runabout to sell for $850 (£130), weighing 650 lbs., travelling at 6, 11 or 14 miles an hour with one charge.

"The Electric Vehicle Co. showed several cars, including a new type of electrically-propelled hansom cab, and a child's automobile, weighing only 330 lbs., travelling about 12 miles an hour for three hours, and perfectly safe for an American child to handle as regards electric contacts.

"Several types were shown by the National Motor Vehicle Co., of Indianapolis. One was driven by a six-pole motor from 32 cells, with a normal capacity equivalent to 2½ H.P., the cells measuring 3¼ in. × 5¼ in. × 10 in. It was said to travel 40 miles at one charge, and costs $950 (£190).

"A very interesting exhibit was that of the Edison Battery Co., who showed a number of Mr. T. A. Edison's new storage cells. Mr. T. A. Edison promises that a battery having a weight of 490 lbs. will drive a car 100 miles without recharging, and that a recharge of an hour's duration will enable a run of 75 miles to be made.

"The stall of the Westinghouse Co. comprised a complete equipment of motors and accessories of their latest patterns for automobiles.

"The Electrical Manufacturing Co., of Dayton, Ohio, showed a new form of magneto igniter for motor engines.

"A gracefully designed open electric stanhope was shown by Studebaker Bros., of New York City."

Vibration in Engineering.—Last Friday evening at the Royal Institution, a lecture on "Vibration Problems in Engineering Science," was given by Prof. W. E. Dalby.

Fire at Niagara Power House.—We give the following on the authority of the *Standard*:—"On the night of January 29th the lightning struck a cable with defective insulation. The short circuit thus caused resulted in the explosion of one of the big transformers in the electric power house operated by the Falls. The firemen refussd to enter the burning building until they had been assured that every generator had been stopped. The delay resulted in the destruction of much valuable machinery, which, in turn, will cause many factories to remain idle for an uncertain time, possibly weeks. At Buffalo, the trolley railways are assisted by storage batteries; some ran a few cars to-day, and others none. At Lockport, 20 out of 55 factories stopped, and every trolley save one line. Lightning has never before caused such serious trouble."

Obituary.—We regret to learn of the death of Mr. James Laister, which occurred on Saturday last, at the age of 66 years. His early years were spent in the service of the old Electric and International Telegraph Co., and he was taken over by the Government in 1870 when the service was transferred. He had done good work as superintendent of the telegraph schools of the Post Office in London, and in educational telegraphic instruction in other parts, and had also held district postmasterships in London. He was an M.I.E.E., and a considerable contributor to the literature of telegraphy and telephony.

Motor-Cars for Inspection Purposes.—The Dudley, Stourbridge and District Electric Traction Co. is now using a 12-H.P. petrol motor-car for inspection purposes in its district. It has been in use since the beginning of December last, in all weathers, and is, we hear, giving great satisfaction.

Motor Transport of Heavy Goods.—Much interest is felt in this subject by merchants and manufacturers in South-East Lancashire. A meeting was held last Friday, in the board room of the Manchester Cotton Association, to consider the possibility of a further introduction of means of transit for heavy goods, by motor haulage along the highways. It was suggested that motor wagons might be used to carry cotton from the Manchester Ship Canal wharves, to Oldham and the surrounding towns; and measures will probably be taken to carry out this project, by arrangement with the tramway authorities. Another meeting will be held shortly to advance the scheme.

Smoking Concert.—A company, numbering over 150, met on Saturday evening, 31st ult., in the Grand Hotel, Glasgow, at a smoking concert in connection with the Glasgow Section of the Institution of Electrical Engineers. The chair was occupied by Mr. Henry Mavor, who was accompanied by Mr. Kingsbury, of London. Mr. Kingsbury, in the course of a brief address, said in no other profession or work had men more worries than in the electrical business, and so it came about that none better deserved, or stood more in need of, recreation. There seemed a natural affinity between music and electricity, and he reminded them that Wheatstone and Hughes were both good musicians.

For Sale.—The Caledonian Railway Co. wants offers for a quantity of electrical plant. See our advertisement pages to-day.

The Institution of Electrical Engineers.—It has been arranged that in the event of the discussion on the metric system finishing last night, the meeting on Thursday next, February 12th, will proceed with the adjourned discussion on Messrs. Scott and Esson's papers.

Newcastle Section.—On Monday last Mr. O. L. Falconar's paper on "Methods of Supporting and Protecting inside Conductors," was again under discussion, and a paper on "Station Notes" was read by Mr. C. Turnbull.

An Electrical Laboratory for New York State.—The New York *Sun* says that the commission appointed by Gov. Odell last spring to inquire into the necessity for establishing a State Electrical Laboratory in connection with the Union College in Schenectady has completed its report, and recommends an appropriation of $275,000 for buildings and electrical equipments. The object of the laboratory is to provide authoritative information on questions of electrical science and an official standard for electrical measuring instruments and apparatus, and standards for electric wiring of buildings for the protection of municipalities and the general public in the use of electrical energy. The Commissioners are State Engineer Edward A. Bond, Charles Steinmetz, of the General Electric Co., and Harold W. Buck.

Personal.—Mr. Joseph Shepherd is recommended as assistant electrical engineer in the tramways department of the London County Council at a salary of £500 per annum. The two other gentlemen in the final list were Mr. A. E. Jackson, principal assistant engineer to Messrs. Kincaid, Waller, Manville & Dawson, and Mr. W. C. Thomson, chief electrical engineer to the Great Northern Railway Co. There were 101 applicants for the position.

Our statement of last week that Mr. G. H. Winsor had been appointed tramways manager at Newport (Mon.) is incorrect, as Mr. H. Collings Bishop, the borough electrical engineer, is also tramways manager under the Corporation, and the sole management of the undertaking is in his charge. Mr. Winsor was manager of the old horse-car lines, and he was recently appointed chief inspector of the electric tramways department.

The Brighton Council has been recommended to appoint Mr. Barnes, of Birmingham, to be telephone manager, at £250 per annum, the appointment to remain in force for two years.

The Tramways Committee of Salford T.C. has recommended that the salary of Mr. E. Hatton, the general manager, from £400 to £500 per annum, and that of Mr. G. W. Holford, chief clerk, from £160 to £180.

Mr. A. Moore has been presented by the employés of the Brush Electrical Engineering Co. with a marble timepiece on the occasion of his marriage.

Prof. J. J. Thomson, D.Sc., F.R.S., will succeed the late Prof. O. N. Rood as Professor of Physics at Columbia University, New York.

On Wednesday last week at the Falcon Works, Loughborough, of the Brush Electrical Co., Ltd., Mr. A. Moore, of the works directors' department, was presented by his colleagues with a handsome marble clock and bronze on the occasion of his marriage Mr. S. Turner, the assistant works' director, made the presentation

Manchester T.C. has increased the salary of Mr. J. T. Oakes, tramway traffic superintendent, from £300 to £350 per annum.

The staff of the Huddersfield Corporation electric supply department have presented a marble timepiece and side ornaments to Mr. J. A. Swift, chief clerk in the department, on his marriage.

Mr. James Toulmin, of Preston, has been appointed chief engineer to the Yorkshire (Woollen District) Electric Tramways Co.

Lecture.—On Friday last, January 30th, Mr. H. S. Meyer, designing engineer, Alternating Current Section of the British Thomson-Houston Co., Ltd., Rugby, lectured before the Coventry Engineering Society, on "Some Points on Alternating Current Systems, with particular reference to Alternating Current Motors," and illustrated his lecture by lantern slides.

Appointments Vacant.—A chief assistant electrical engineer at Ashton-under-Lyne at £150 a year; an assistant engineer at Edinburgh at £100; an assistant electrical engineer at Lowestoft at £120; shift engineer for Erith at £91; Southend-on-Sea requires an assistant electrical engineer at £150. See "Official Notices" to-day.

The Marylebone Award.—The Hon. C. Russell has issued his award in the M.E.S. and Marylebone arbitration, the proceedings of which have been fully recorded in our columns. He fixes the price payable by the Corporation to the company at £1,212,000. The effect of this announcement on the Stock Exchange yesterday was to send the shares of the M.E.S. Co. up from 17 to 21, and they afterwards fell back to 20.

Norwich Electricity Works.—We learn that the purchase of the business of the Norwich Electricity Co., Ltd., was completed by the Corporation on Saturday last, the shareholders receiving an amount equivalent to £19 per £10 share. The business was formally handed over on Monday.

Rosling & Fynn.—We learn that the Phœnix Dynamo Manufacturing Co., of Bradford, have purchased from the liquidator of Rosling & Fynn, Ltd., the whole of the works, business, and patent rights, and intend, after some extensions to the buildings are completed, to consolidate the plants at Thornbury. They will eliminate from the two plants any machinery which is not up to date, and substitute modern and specialised tools.

THE CENTRAL STATION ENGINEER.

On Tuesday, January 27th, an interesting ceremony took place at the works of the Folkestone Electricity Supply Co., Ltd., when Messrs. J. Hayward Home and Glynn Salter were each presented with a handsome marble clock on leaving to take up their respective appointments as resident engineers for Messrs. Edmundson's at Berwick-on-Tweed and Lymington. Mr. Charles Wakeley was presented with a silver fish service on the occasion of his marriage. The presentations were made on behalf of the staff and employés by Mr. Thomas Hesketh, managing engineer.

In connection with the power station at Newcastle-on-Tyne, the Tramways Committee has divided the work of Mr. Harry Richardson (lately appointed borough electrical engineer at Dundee), giving one portion to Mr. Claughton and the other portion to Mr. Dalton, at a salary of £200 a year in each case, both having been employed at the power station.

The Hornsey D.C. had 81 applications for the post of chief assistant electrical engineer at 50s. a week, and appointed Mr. Arthur Howell, of King's Lynn. For the post of electrician-in-charge there were 54 applications, and Mr. G. H. Baker, of Southampton, was chosen. There were 85 applications for the post of junior electrician.

Mr. C. H. Heron, chief assistant at Worksop Electricity Works, has been appointed resident engineer at Elland U.D.C.'s Electricity Works.

Mr. A. B. Irish, late engineer-in-charge at Bedford Electricity Works, has been appointed as engineer-in-charge at the Eastbourne Electricity Works.

Mr. F. Bruton has resigned his position as assistant engineer at the Ashton-under-Lyne Electricity Works, having obtained another appointment.

The Coventry T.C. has decided to increase the salary of the borough electrical engineer to £400 per annum.

Mr. C. W. Kennaway having resigned his position as resident electrical engineer to the Whitby U.D.C., Mr. L. H. King, chief assistant engineer, has been appointed in his place.

Mr. McKail, senior assistant at the Dundee electricity works, has been appointed acting engineer during the time between Mr. Tittensor's departure and the arrival of Mr. Richardson, the new engineer.

ELECTRIC TRAMWAY ACCOUNTS.

Leeds City Tramways.

The returns here given of the tramways operated by the Corporation of Leeds afford substantial proof of the developments which have characterised the undertaking since its absorption by the municipality.

The systems of haulage comprise electric, steam and horse, and a comparison of the ratio of receipts and working expenses in each case should afford the ratepayers cause for congratulation on the transformation to electrical working which is taking place.

As is usual in the financial statement for a combined undertaking of this character, the accounts do not readily lend themselves to dissection for the individual systems.

The relative positions of the systems for the year ending March 25th, 1902, are as follows:—

	Electric.	Steam.	Horse.
Total mileage	4,096,607	463,046	166,390
Receipts per mile	11·47d.	10·93d.	6·16d.
Working expenses per mile ...	6·63d.	10·41d.	10·29d.

It is, however, only fair to add that the steam and horse sections have run a decreased mileage of 51,721 and 675,905 respectively. The working expenses are for the steam ·64d. lower, and for the horse ·77d. higher per mile than in the previous year; and the receipts in the two cases show decreases of 1·19d. and 1·26d. per mile respectively.

The tramways were purchased by the municipality in February, 1894, and the first electrical sections were opened in August, 1897. The total length of route is 41 miles, and of single track 76½ miles; extensions under construction during the year amounted to 1¾ miles. The total capital expenditure to September, 1902, equalled £1,005,202, and the number of passengers carried was 48,270,000, an increase of nearly 10,000,000 on the previous year. The receipts and working expenses for the electrical section during the years ending March, 1901 and 1902, were as follows:—

	1901.	1902.	Inc.
Total electric car receipts ...	£133,449	£195,882	£62,433
Total electric car mileage ...	2,506,655	4,096,607	1,589,952
Receipts per mile	12·77	11·47	—1·30
Working expenses per mile	6·07	6·05	—·02

These results show that a large increase has taken place in the electrical mileage, which, after deducting the respective decreases in the horse and steam sections, is still 862,326 miles to the good, and we may infer that the public have benefited during the past year by a greatly augmented service of cars at the cost of a slight decrease in receipts and increase in working expenses per mile in each case.

An analysis of the working expenses is as follows:—

		Per mile. 1902.	1901.	Inc.
Drivers' and conductors' wages, &c.	£40,748	2·37d.	2·23d.	·14d.
Generating expenses	6,793	·39d.	·60d.	—·21d.
Battery station expenses	97	·00d.	·00d.	·00d.
Car shed expenses	22,129	1·27d.	1·41d.	—·14d.
Engineers' salaries	894	·04d.	·06d.	—·02d.
Road maintenance	11,000	·64d.	·19d.	·45d.
Compensation	496	·02d.	·06d.	—·04d.
Administration charges and general expenses (proportion) including rates, insurance, repairs, printing, salaries of manager and staff, inspectors, timekeepers, &c., uniforms, income-tax and sundry other items.	22,740	1·32d.	1·52d.	—·20d.
Total expenditure ...	£104,899	6·05d.	6·07d.	—·02d.

It will be seen that generating costs show a satisfactory decrease of ·21d. per mile, which, however, is more than counterbalanced by road maintenance, which has increased by ·45d., other items being practically stationary. In the car shed expenses car repairs figure at ·63d., and wages ·64d. per mile, as compared with ·85d. and ·56d. for the same items in 1901. The following particulars are also of interest:—

Car-miles by motors	4,094,640
„ trailers	1,966
Units used for traction	4,838,258
„ „ arcs and car sheds	393,796
Total units used for tramways	5,232,054

The total generating costs amount to ·33d. per unit net, but allowing for sundry sales for lamps, this becomes ·38d. per unit. The units used per car-mile are 1·11, compared with ·917 in the previous year.

The gross receipts amounted to £195,882, and the total expenditure to £104,899, leaving a gross profit of £90,983, out of which a sum of £9,843 was allocated for depreciation of cars, and the balance of £81,140 remains to meet interest, sinking fund, and depreciation charges for the remainder of the plant and buildings.

Mr. J. B. Hamilton is the Leeds Corporation tramways manager, Mr. J. Burbridge being chief engineer.

ELECTRICITY SUPPLY ACCOUNTS.

Coventry Municipal Electricity Accounts.

The electrical undertaking of the Borough of Coventry, whose accounts for the half-years ending 1901 and 1902 are analysed this week, is worked under unfortunate conditions. In 1901 the generating station contained a considerable proportion of old-fashioned and uneconomical plant, the load factor was very small, and the system of charging for energy very unpopular with consumers. The concern was also heavily capitalised, and in other particulars at a disadvantage.

With the object of improving this state of things, Mr. Jeckell, the borough electrical engineer, introduced various improvements in the way of newer and more economical plant, a reorganisation of staff, and of the system of charging for energy, the prices for both light and power being reduced. He also decided to try the hiring out of motors for power purposes.

It is, however, not surprising that the undertaking is carried on at a loss—and the engineer is to be congratulated on having substantially lessened the amount of the deficiency by the sum of £941 for the later period, and this in spite of the decreased average price per unit obtained.

The gross expenditure for the period under review was as follows:—

	1901.	1902.
Station charges	£2,221	£1,617
Capital charges	2,080	2,143
Total	£4,301	£3,760

General Statement.

For half-years ending September ..	1901.	1902.	Inc.
Number of units sold	118,586	£148,678	£30,092
Number of lamps connected ...	24,784	29,521	4,737
Maximum load in kw.	311	—	—
Gross revenue	£2,277	£2,678	£401
Gross expenditure...	£4,301	£3,760	—£541
Gross profit	—£2,023	—£1,082	—£941
Average price per unit sold ...	4·60d.	4·32d.	—·28d.

During the half-year ending September, 1901, the units sold for private and public lighting were 93,500 and 25,086 respectively, as against 127,606 and 21,072 for the same period in 1902, the revenue from public lighting remaining unchanged.

Revenue Statement.

	1901. Gross	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Sale of energy—					
Street lighting	£400	·81d.	£400	·64d.	—·17d.
Private lighting	1,803	3·64d.	2,192	3·53d.	—·10d.
Meters	74	·14d.	86	·13d.	—·01d.
Gross revenue ...	£2,277	4·60d.	£2,678	4·32d.	—·28d.

It will be noted that a satisfactory decrease has taken place in the cost of coal, equal to nearly ¾d. per unit, and practically all the items are less than in 1901, the total decreased cost per unit being 1·89d.

Cost of Production.

Half-year ending	Sept. 30, 1901. Gross.	Per unit.	Sept. 30, 1902. Gross.	Per unit.	Inc.
Coal	£670	1·36d.	£393	·68d.	—·72d.
Oil, waste, water and engine room stores and carbons.	93	·18d.	84	·13d.	—·05d.
Salaries and wages incurred in generation and distribution and attending to public lamps.	686	1·39d.	442	·71d.	—·67d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and renewal of public lamps.	229	·52d.	135	·21d.	—·31d.
Works costs ...	£1,678	3·45d.	£1,055	1·70d.	—1·75d.
Management expenses, salaries of engineer, secretary and clerks.	232	·46d.	315	·50d.	·04d.
General establishment charges, stationery, printing, &c.	91	·18d.	52	·08d.	—·10d.
Rent, rates and taxes ..	158	·32d.	161	·25d.	—·06d.
Insurance	33	·08d.	34	·05d.	—·02d.
Total costs ...	£2,221	4·49d.	£1,617	2·61d.	—1·89d.

With an increase of revenue of £401, and a decrease in working expenses of £541, the net loss fell £941, and the deficit for the half-year was £1,082, as compared with £2,023 in the previous year.

CITY NOTES.

Metropolitan Electric Tramways Co.

Mr. E. Garcke presided at the meeting of this company held at Salisbury House, E.C., on Friday last. There was a large gathering of shareholders, and the chairman went in a most careful and detailed manner into the affairs of the company. He said that although no public issue of the capital of the company had been made they had 2,500 shareholders, and there was a subscribed capital of about £750,000. That arose out of the arrangement made with the North Metropolitan Tramways Co.'s shareholders, who had agreed to exchange their shares in that company for shares in this, and also out of the fact that the B.E.T. Co. had agreed to take payment for the various assets which they were transferring in this company entirely in ordinary shares. This was the first occasion on which the directors had met the shareholders, therefore, he would refer to the origin of the company, then give particulars of its rights and properties and valuable concessions; then he would refer to the capital requirements of the company; and finally discuss the present profits and future prospects. In the course of his very lengthy speech on these points, which the limits of space prevent our printing at all fully, Mr. Garcke said that the company was registered as long ago as 1894 under the title of the Metropolitan Tramways and Omnibus Co., but until last year, when the B.E.T. Co. took that company in hand, the latter had only seven shares subscribed. They had, however, been engaged for some time, with the assistance of a syndicate, in which the B.E.T. Co. was largely interested, in promoting light railway orders in the counties of Middlesex and Hertford. Many of these orders had been secured, and others were in course of being completed. Regarding the company's assets and concessions, they had the large holding he had mentioned in the North Metropolitan Co., which, under lease from the London County Council, was working about 48 miles of tramways by horse-power. The County Council, however, had given notice of its intention to convert some important sections of the lines to electric traction on the overhead system, and friendly negotiations were pending between the County Council and the North Metropolitan Co. respecting the electrical working of the rest of the tramways. Another important asset of this company consisted of 7½ miles of tramways in the county of Middlesex, which until quite lately belonged to the North Metropolitan Co., but which had been purchased, with the approval of the Board of Trade, by this company for £200,000, of which £50,000 was payable in cash, while the other would be satisfied by their taking over the obligation of the North Metropolitan Co. in regard to the issue of £150,000 of 3½ per cent. debentures. The seven and a half miles of line ran from Finsbury Park to Wood Green and from Finsbury Park to Edmonton, and formed a continuation of the other tramways of the North Metropolitan Co. This purchase also included the beneficial user by this company of one mile of line in the County of London which was not subject to the lease of the Council. The tenure of the seven and a half miles of line was rather an important feature. They could not be purchased by the local authority under the 43rd section of the Tramways Act of 1870 until 1925, and in the case of Tottenham not until 1930. Moreover, by an Act of Parliament obtained some time back, this company was authorised to convert these tramways to the overhead system of electric traction—a work which the directors intended to proceed with forthwith. With respect to the important concessions which they had secured under the Light Railways Act in Middlesex and Hertfordshire, when the whole of the proposed lines had been sanctioned and the contemplated scheme had been completed, the company would have the working of 50 miles of light railways immediately continuing the tramways referred to, and they would all be worked by electricity and equipped on the overhead system. Their tenure in connection with these light railways would be in the form of leases for 30 years in the case of Middlesex and 42 years in the case of Hertfordshire. Under those leases the capital required for constructing the lines would be provided by the County Councils of Middlesex and Hertford, and the company would find the capital necessary for providing the electrical equipment and the rolling stock. At the expiration of the leases the company would be paid for the electrical equipment and rolling stock on the basis of operations as going concerns, so that the whole of the capital would be repaid to the company at the end of the leases. The capital to be provided by the County Councils would carry 4½ per cent. interest in the case of Middlesex and 4 per cent. in the case of Hertford. Then the company would be entitled to interest on the capital—4½ per cent. in the case of Middlesex and 6 per cent. in the case of Hertford. The capital would thus be raised on the most economical terms that could be arranged. It was not reasonable to expect payable terms from local authorities unless a *quid pro quo* were given, and the *quid pro quo* in this case was that the Middlesex and Hertford County Councils would share in the net profits after the payment of all interest charges and expenses. In the case of the Middlesex lines, 45 per cent. of the net profits would go to the County Council, and 55 per cent. to the company, while as regarded Hertford, the County Council would take 40 per cent. of the net profits, and the company 60 per cent. They heard a great deal nowadays about the conflict between municipal trading and private enterprise, and it, therefore, afforded him particular pleasure to be able to refer to this case, in which all possibility of such conflict was removed. He thought that the united Councils of Middlesex and Hertfordshire had been actuated in that matter by what would prove to be a thoroughly statesmanlike principle. The two County Councils had made an arrangement with the company by which the interests of the latter, acting as agents for the local authorities, were made identical, not only with the interests of the public, but with those of the ratepayers; and he ventured to think that the arrangement made was a very much more statesmanlike proceeding than the course frequently taken by local authorities who, actuated by a spirit of jealousy towards private enterprise, undertook the risks of trading or, alternatively, squeezed private enterprise to such an extent that it was unable either to do justice to its shareholders or to the public. The company would also shortly possess 3,600 shares in the Harrow Road and Paddington Tramways Co., or rather more than half the share capital of that company, which owned about 3½ miles of lines forming a link between some of the authorised light railways he had referred to, and bringing the latter to a point nearer London than would be possible if this company did not control the Harrow Road and Paddington Co.'s undertaking. A Bill was being promoted for the next session of Parliament to authorise these lines to be equipped with the overhead system of electric traction and to authorise a small extension in order to join them up with one of the proposed light railways in the Edgware Road. The company had obtained running powers over the tramways in Watford when the latter were constructed; and it had also been successful in arranging for running powers over the light railways promoted by the District Council of Walthamstow. This would enable it to carry passengers on its system direct to Epping Forest, which was at present almost inaccessible to a very large proportion of the immense population in the north of London. An arrangement had been made with the London United Tramways Co. by which the two companies had agreed not to interfere with each other's promotions in their respective areas. Mr. Garcke later referred to a proposal that this company should purchase the shares held by the B.E.T. Co. in the North Metropolitan Electric Power Co., which owned powers for the supply of electricity in bulk within an area in the counties of Middlesex and Hertford. The purchase was not yet completed, but it would probably involve the payment of about £45,000, and payment would be accepted by the B.E.T. Co. entirely in ordinary shares of this company. In regard to the capital requirements of the company, although the proposed undertakings were enormous, they had made very economical financial arrangements. Estimates which had been carefully prepared showed that probably £750,000 would suffice, and this would not have to be raised all at once, but only as the works proceeded. They would probably make an issue of capital shortly, but the remainder would be issued slowly by instalments. After a brief reference to some items in the balance-sheet, and showing how very bright were the future prospects of the concern, the chairman moved the adoption of the report.

Sir Ernest Spencer seconded the motion, and after a few remarks had been made by shareholders, and replied to satisfactorily, it was carried unanimously.

City and South London Railway Co.

Mr. C. G. Mott (chairman) presided on Thursday last week at the offices over the meeting of the above company, and in moving the adoption of the report (which appeared in our issue of 23rd ult.) said he was glad to be able to meet the shareholders that day with the highest dividend they had ever yet paid. It was satisfactory that they were able to recommend a dividend of 3½ per cent., but although it was the highest they had yet paid, he hoped it would by no means be the highest in the future. The traffic of the line

was making steady progress, and there was little reason to doubt that the advances made in the last year or two were likely to continue. It may have struck some of them as a remarkable fact that, although the line was paying a larger dividend than that paid by many of the other larger railways, yet the stock of the company stood some 20 or 25 per cent. less value in the market than the other companies. That, no doubt, arose from the fact that the public had not yet realised the real substantial value of the stocks of these electrical Metropolitan railways. They had no goods traffic, and consequently were not liable to the fluctuations as was the case with the large railway companies, which depended largely on their goods traffic, and therefore for the permanent investor the stocks of these electrical railways, depending as they did entirely on passenger traffic which was not likely to be affected, offered a steady investment liable to very little fluctuation, and he felt sure that in the future it would come to be more and more appreciated. Both the debenture stock and the preference stock were in the list of trustee securities, and yet they stood at a price very much below that of other railways. The investing public certainly would one day wake up to the fact that they had neglected stocks which were of very great value. Turning to the capital accounts, they would see that they had received for debenture stock sold, and the premium upon it, £46,975, and they had expended £15,054, almost the whole of which was in payment for the retention due to the contractors. The result was that they had a balance on capital account of £31,921. The balance at the debit of capital account on June 30th was £60,476. It was reduced on December 31st to £28,555, and the difference was the £31,921 he had just mentioned. The balance-sheet was the clearest and simplest they had yet had. They had paid off all the loans that were owing by the company which had stood so often in the accounts, and they were now in a very happy financial condition. Turning to the revenue account, the passengers showed an increase in number of 2,768,820, compared with the corresponding period of last year, and there was an increase in money of £21,807. They must, however, recollect that last year the extension to Islington was only opened for about six weeks, and therefore it was not by any means an ordinary fair comparison between the two half-years' working. They had increased the number of season ticket holders by 609, and the amount by £590. That amount would have been considerably larger, but they made an alteration a short time ago by allowing quarterly season tickets at the same rate proportionately to a yearly ticket. The result had been that a great number of tickets were renewed for a quarter, and they had obtained a large number of new ticket-holders, and in the present half-year they would see a considerable increase in the receipts from season ticket-holders in consequence. Last half-year it told against them, but in the current half-year it would tell in their favour. The parcels had increased by £131, and the transfer fees by £49, and rents by £572, and the total increases were £23,148. On the other hand, there was a decrease in sundry receipts of £110, so that the net increase was £23,039. The decrease in sundry receipts was an exceptional decrease caused by some miscalculation in the previous half-year with regard to the receipts from the Coronation letting of seats which had to be made good this half-year. On the expenses side maintenance showed an increase of £573; locomotive and generating power by £2,393; carriage repairs by £446; traffic expenses by £3,489; general charges by £296; law charges by £83; and rates and taxes by £1,124. The last item was an ever-increasing quantity, and he hoped something would be done to reduce it, for there seemed to be a general consensus of opinion that some steps would have to be taken. It was constantly increasing half-year by half-year, and they had no power to stop it. It rested with shareholders in their various districts to keep down the rates. The passenger duty showed an increase of £52, which was attributable to the increased receipts from passengers. The total increase of charges was £8,456, against an increase in receipts of £23,039; which gave them an increased balance of £14,583. The debenture stock interest had increased by £1,826, and the interest on loans, &c., which were now paid off, and would not occur again, was £291. That left a total increase of balance available for dividend of £12,466, and they were enabled after payment of 5 per cent. on the preference stock to recommend a dividend of 3½ per cent. on the ordinary stock, and carry forward £1,268 17s., as against £1,425 last year. They would like to know, as usual, the comparison of percentage. In the first place, the miles run last half-year were 625,883 against 495,106. That was attributable to the opening of the line to Islington. The number of trains run was 102,185, against 97,445; the number of passengers, 9,877,191, against 7,108,379; the number of passengers per train, 96·66, against 71·92; receipts per train were 16s. 1d., against 12s. 3d.; and the receipts per train-mile, which was much more important, were 2s. 7·7d., against 2s. 4·96d. The receipts per passenger, curiously enough, gave a slight decrease, viz., 1·95d., against 1·97d., which was do to the large number of short-distance passengers, and also to the increase in the workmen carried at a very low rate in the morning. The working expenses formed, perhaps, the most satisfactory item of the whole, for it showed 44 per cent. against 46¾ per cent. in the corresponding period last year. He believed that was the lowest rate of working expenses that any English railway ever had, and if they took out the cost of working the lifts, it was reduced to about 37 per cent. for the railway itself pure and simple. They would see that the Waterloo and City Railway had done exceedingly well this half-year, and that their working expenses had been reduced to 44¾ per cent., but that railway had no lifts, and, therefore, of course, the South London Railway rate of expenses for the railway itself *per se* was considerably less than the Waterloo and City, although the latter company was worked in an exceptionally favourable way by the South-Western Railway. The expenses per train-mile were 1s. 2·46d., against 1s. 2·28d.—a slight increase; the locomotive and generating power expenses were 4·55d., against 4·59d.; and the traffic expenses were 6·3d., against 6·29d. With regard to the report, it would be seen that while in 1892, after 2¼ years' working they carried, exclusive of season ticket holders, 6,000,000 people, in 1902 they carried 19,000,000. He now came to the important question of Parliamentary Bills. The first was the Bill for the extension to Euston, King's Cross and St. Pancras. That Bill, after passing a Joint Committee of both Houses of Parliament, was rejected by a Lords Committee without any reason being given, their only opponent being the Metropolitan Railway. They were going to reintroduce that Bill, and trusted it would be passed, for it was one essentially in the public interest. It would unite the railway with four great railways, and would join the railways of the North to the railways of the South, and afford an outlet from the City for a very large population, by these main lines of railway, into districts which are perhaps the least developed round London. It would create an entirely new traffic, of which the Metropolitan would get its share, and it appeared to him a short-sighted policy on their part to oppose the Bill. With regard to the City and Brixton Bill, they knew that line was promoted by an independent company, and the City and South London agreed to work it on certain terms. They considered the amount they offered was as much as they could fairly give, but financial men in the City required big profits, and nothing was done. The line was to be a continuation of their old abandoned line from the old station at the Borough. That line was lying useless, and, of course, they were anxious to see the Brixton line carried out so as to get the line into use, but they were not prepared to carry it out on terms which they were not certain would be profitable to the company. The result was that last year the promoters agreed to carry out a shorter line with a smaller guarantee, and they hoped that the arrangement would have gone through. But there were several parties in the field, and they heard that a line was going to be constructed in direct opposition to them. They thought, therefore, on the whole, that it would be better, if possible, if they got control of the Bill, and so they had made arrangements, subject to obtaining the powers, to take over the powers of that Bill, if Parliament approved, and to carry out the powers when they could see that the line could be economically constructed. Circumstances had greatly changed since they first recommended the shareholders to take over the line. The traffic of the line had developed very largely, and the old station at King William Street was too small for the terminus of a large line. What they therefore proposed to do was to make a thoroughly first-class terminus in the City, and to ease the gradients of the approaches. They proposed to construct a station between the present station at the corner of Lombard Street and the King William Street statue, and have a double station at London Bridge, where the traffic was considerably increasing, and where the exchange with the London and Brighton and other railways was going on. As to whether the railway was going to pay, they had to consider that they had an abandoned line, and if they allowed the Brixton line to go, it might be considered practically worthless. The length of the Brixton line would be 4¼ miles, and it would not cost much more than £250,000 a mile, as against the £700,000 to £850,000 a mile of other railways being promoted. Therefore, they believed it would be no burden on the company. It would increase the traffic of the existing line, and he had not the slightest doubt but that they would get a very good return from the Brixton Railway itself. He was getting an old man, and would prefer not to have the worry of extensions, but in these days they could not stand still. At the same time they must see that they did nothing to risk the present condition of the railway, but he felt himself that it was in the interests of the company that they should go into this. When all their connections with other railways were completed, anyone would be able to go from their Bank Station to any part of the metropolis they desired without having to traverse the streets between any station, and that he considered was the only way in which the problem of London locomotion could be dealt with.

Mr. C. S. Grenfell seconded the motion.

Replying to questions, the Chairman said the railway had more than one size of tube, but that he felt that a 10 ft. 6 in. tube was sufficient for their purposes.

The resolution was carried.

Subsequently the necessary resolutions approving of the company's Bill were agreed to.

Great Northern and City Railway Co.

Sir Chas. Scotter presided at the half-yearly meeting held on Monday at Westminster Palace Hotel, and he explained the progress which had been made with the work in the tunnels and at the power station up to January 30th. In regard to the rolling stock, six trains of seven coaches had been delivered, and two more were ready at the makers' works. The lifts at Moorgate Street were ready to run; they only required finishing off. A commencement would shortly be made with the operations at Lothbury and Highbury. Practically they could really complete the line between Drayton Park and Moorgate Street, and work it as a section, within the next three or four months, but the board and the contractors had, after consideration, come to the conclusion that it would not be advantageous to open a section. They could not profitably open until the extension to Finsbury Park was finished. The work was being pushed on with all speed. Every difficulty with the Great Northern Railway had been removed. Shareholders would not suffer through the delay, because arrangements had been made whereby the

3 per cent. on the capital would be paid up to June, 1904, at which date there was no question that the extension would be completed. The extension to the Bank was almost as important as that to Finsbury Park, but the opening of the line would not be contingent on the completion of that section of the railway. As soon as the Finsbury Park Station under the Great Northern Railway was finished, they proposed to open the line from Finsbury Park to Moorgate Street. During last year they had added 102 new shareholders to the register. About three weeks ago the track was so far advanced that they had some experimental runs, and nothing could have been more satisfactory. He remembered that the first experimental train of the Waterloo and City Railway broke down, and they had to walk out of the tunnels, but on the Great Northern and City experiment no mishap took place. Experiments had been conducted since then, both as regards weight and speed. The weight of the train and its motors was 150 tons, three times that of the experimental train on the Waterloo and City line. For a considerable time they had run between sections at the rate of 40 miles an hour for 60 minutes. They did not anticipate running at 40 miles, but the experiment showed that they had ample power for all purposes.

The Earl of LAUDERDALE seconded the adoption of the report.

In reply to shareholders' questions, the CHAIRMAN said that the extension to Finsbury Park would be completed by the end of this year, so that there was no reason why the line should not be opened for work by March, 1904. Six months after that the Lothbury extension would, he thought, be completed.

The report was adopted, the retiring directors re-elected, Mr. Steel elected a director, and Messrs. W. B. Peat & Co. were re-appointed auditors.

The meeting then became special, and passed resolutions respecting the company's Bills, which are to come before Parliament shortly. One Bill related to the extension to the Bank and the station at Highbury, for which they needed capital. They found that they could not raise the money under the terms originally sanctioned by Parliament, so they were asking for powers to raise it by 4 per cent. preference shares if they thought proper. The second Bill was really to obtain power to give certain consent to the G.N.R.; it was necessary for the purposes of Parliamentary procedure.

Liverpool Overhead Railway Co.

THE directors' report, which is to be submitted to the meeting on February 10th, says:—

In presenting the half-yearly statement of capital and revenue accounts to December 31st, 1902, the directors have to report that the gross revenue receipts amount to £41,263 11s., and the working expenses to £31,118 2s.

The number of passengers carried during the last two years is as follows:—

	Half-year ending June 30th, 1901.	Half-year ending Dec. 31st, 1901.	Half-year ending June 30th, 1902.	Half-year ending Dec. 31st, 1902.
First class	721,999	708,740	656,756	719,287
Second class, including tramways	3,157,111	3,321,856	2,966,690	3,384,621
Workmen (special return tickets)	1,503,114	1,402,858	1,402,976	1,336,396
Total ..	5,382,224	5,433,454	5,026,422	5,440,304

The accelerated service referred to in the last report came into operation on October 1st and the results have been satisfactory. Bills have been deposited in Parliament by the Cheshire Lines Committee for powers to effect a junction with our railway at the Herculaneum Dock, and by the Seaforth and Sefton Junction Railway for powers to construct a new line connecting the Southport and Cheshire Lines Extension Railway at Sefton with our line at Seaforth. Negotiations are still in progress with the Lancashire and Yorkshire Railway Co. for effecting a junction at Seaforth. Your directors much regret the retirement of Mr. John Brancker, the representative of the Mersey Docks and Harbour Board, and desire to express their great appreciation of his constant and valuable services. Mr. Reginald Bushell has been nominated by the Mersey Docks and Harbour Board in his place.

REVENUE ACCOUNT.

	£	s.	d.
Receipts from passenger traffic amount to	40,313	0	7
Miscellaneous receipts and interest	950	10	5
	41,263	11	0
Less working expenses	31,118	2	0
	10,145	9	0
Deduct interest on mortgage debentures	3,800	0	0
	6,345	9	0
Add balance brought forward, June 30th, 1902	3,792	19	7
Leaving available for dividend	10,138	8	7

Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after February 14th, next:—

5 per cent. per annum on preference shares	£3,000	0	0
1½ „ „ ordinary shares	3,125	0	0

leaving a balance of £4,013 8s. 7d. to be carried forward to next half-year.

Charing Cross and Strand Electricity Supply Corporation.

THE directors' report for the year ended December 31st, 1902, congratulates the shareholders on the satisfactory results of the year's trading in both the West End and City areas of supply.

"*The West End Undertakings.*—The progress of the business in the West End areas is highly satisfactory; no fewer than 34,364 additional 8-C.P. lamps have been connected, exceeding those connected last year by 23 per cent., making a total of 280,605 8-C.P. now connected, while the units sold during the year 1902 show an increase of 26 per cent. over those sold during the year 1901. As was the case last year, a portion of this increase is due to the fact that the West End undertakings supplied all the energy used by the City undertaking for a considerable period during the early part of the year. The revenue from sales of current for 1902 amounts to £114,358, as against £99,715 for 1901, or an increase for the year of 14½ per cent. The engineer-in-chief certifies that the plant, machinery and mains have been maintained in a high state of efficiency. There have been added 40 miles of mains to the system in the West End areas, making a total of 204 miles. Trunk mains from the generating station at Bow to the West End are in regular work, thus enabling the corporation to take a large supplementary supply from Bow when considered desirable. In addition to their present plant, the distributing stations at Short's Gardens and St. Martin's Lane are being equipped with supplementary motor-generators and battery plant, for dealing with the supply of energy from Bow as well as the principal supply from the Lambeth station. The net earnings of the West End undertaking, as shown in the net revenue account No. V. have amounted to £49,398 6s. 1d., to which has to be added £10,650 10s. 3d. brought forward from the year 1901, making a total of £60,048 16s. 4d.; £10,000 was distributed as interim dividend at the rate of 8 per cent. for the half-year ended June 30th, 1902, and there remains a sum of £50,048 16s. 4d., which the directors propose to deal with as follows:—

Dividend on 4½ per cent. preference shares apportioned to December 31st, 1902..	£15,187	10	0
To pay a dividend at the rate of 12 per cent. for the half-year ended December 31st, 1902, on ordinary shares, making with the interim dividend paid in August, 1902, 10 per cent. for the whole year	15,000	0	0
Reserve amount of guaranteed preference dividend of the City Undertaking up to December 31st, 1902 ..	5,044	10	2
And to carry forward	14,816	16	2
	£50,048	16	4

The City Undertaking.—The works in connection with the City Undertaking were carried out by the Charing Cross and City Electric Co., Ltd., and the engineer of the corporation has certified £569,202 7s. 6d. as being due to that company under the works' contract and the supplemental works' contract entered into between this corporation and the company, and in settlement there has been issued to the Charing Cross and City Electric Co. £200,000 City Undertaking ordinary shares, and £369,202 7s. 6d. has been paid in cash. The progress of the business has more than realised the expectations of the directors. The revenue from the sales of current amounted to £27,774 0s. 10d. in 1902. The engineer-in-chief certifies that the plant, machinery and mains have been maintained in a high state of efficiency. The first section of the generation station at Bow, equipped with machinery and plant of the most powerful and efficient kind, is in regular work; the building will afford space for the installation of further plant of 10,000 KW. capacity. The trunk mains from Bow to the City sub-stations have also been completed and used, while mains linking the whole of the City sub-stations have been laid and connected up. In the City 85½ miles of distributing and feeder mains have been laid, making a total of 186½ miles laid. The sub-stations at Fenchurch Street, Upper Thames Street, and Ludgate Hill, equipped with motor-generators and storage batteries, are in regular use distributing energy within the City. A supplemental supply to the City distributing stations has been provided from Lambeth, and this supply, together with the battery plant installed at the distributing stations, has been of the greatest value in ensuring reliability of supply to the consumers, besides enabling the business to be worked in the most economical manner. It was not proposed to proceed with the erection of the distributing station in Beech Street, but owing to the unexpectedly heavy demand in the northern area of the City, this work has now become imperative, and is being proceeded with. In the meantime the district is being fully and efficiently supplied by the other sub-stations. 98,893 8-C.P. lamps have been connected to the City mains during the past year, making, with the 51,836 lamps connected in 1901, a total of 150,729 lamps. The demand for the company's supply still continues to be exceedingly satisfactory; contracts are signed and negotiations pending for additions of approximately 110,000 8-C.P. lamps. Requirements for motive power are largely increasing, and many of the newspaper and printing establishments are taking, or about to take, their supplies of energy from this corporation in lieu of the various forms of motive power now in use by them. The revenue account, No. 4, shows a profit of £4,674 8s. 5d. The net revenue account shows a debit balance of £270 7s. 5d. The £5,044 10s. 2d. 4½ per cent. preference share dividend to December 31st, 1902, guaranteed by the corporation's West End undertaking, has been paid."

Dublin United Tramways Co. (1896).

THE report for the half-year ended December 31st states that the amount available for division is £40,240, out of which dividends for the half-year are recommended at the rate of 6 per cent. per annum on the preference shares and at the rate of 6 per cent. per annum on the ordinary shares. These dividends will absorb £34,875, leaving a balance of £5,365 to be carried forward. A sum of £3,000 is included in the revenue account towards the expenses of the action of Fitzgerald *v.* the Dublin United Tramways Co. Owing to increased valuation of the tramways, and to further advances in the rates levied both in the city and suburbs, the amount charged against the revenue of the half-year on this account shows an increase of £2,334.

South London Electric Supply Corporation, Ltd.—The directors recommend, subject to final audit, a dividend on the ordinary shares at the rate of 1½ per cent. for the past year.

Giant's Causeway Railway and Tramway Co.

Dr. Anthony Traill presided at the meeting of this company held at Portrush last week. The directors' report stated that the receipts amounted to £3,357, as compared with £3,285 in the previous year, and that the number of passengers had risen from 105,939 to 107,258. The credit balance or net profit on the year's working was £1,263, as against £1,040 in 1901 and £934 in 1900. The increase in net profits was attributed principally to the successful working of the new overhead electric system, which provides greater power and more rapid transit than the old method. Four per cent. is to be paid on the debenture stock and 4 per cent. on the mortgage of £10,000 borrowed for the construction of the Giant's Causeway extension, leaving a balance of £313 to meet temporary requirements. The engineer's report stated that the portion run by electricity cost 4d. per mile, and that by steam 1s. 4d.—The report was adopted.

Anglo-American Telegraph Co.

The following report is to be submitted to the meeting to-day:—

The total receipts from July 1st to December 31st, 1902, including the balance of £4,727 12s. 2d. brought forward from the last account, amounted to £199,420 18s. 11d. The traffic receipts show an increase of £9,798, as compared with the half-year ended December 31st, 1901. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £64,214 6s. 2d., being an increase of £700 8s. 9d. over the corresponding period of 1901. The directors, under the powers conferred upon them by the Articles of Association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £117,206 7s. 9d. Interim quarterly dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on November 1st last, absorbing £53,500, leaving a balance of £64,706 7s. 9d., out of which the directors recommend the proprietors to declare final dividends of 18s. per cent. on the ordinary stock, £1 15s. per cent. on the preferred stock, and 1s. per cent. on the deferred stock, payable on February 7th, amounting to £63,000, making a total distribution for the year ended December 31st, 1902, of £3 0s. 6d. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and 1s. per cent. on the deferred stock. The balance of £1,706 7s. 9d. will be carried forward to the next account. The cables and landlines of the company are in good working order.

Bristol Tramways and Carriage Co.

The directors' report to be presented to the meeting at Bristol on February 9th reads:—

The gross receipts for the year ending December 31st, 1902, amount to £237,447 3s. 5d., and the working and general expenses and renewals are £155,430 9s. 5d., leaving a net revenue of £82,017 0s. 1d. The following amounts have already been distributed, viz.:—Interest on 4 per cent. mortgage debenture stock, and temporary loans, £10,229 9s. 9d.; dividend on 4 per cent. preference shares, £18,800; interim dividend at the rate of 8½ per cent. per annum (subject to income-tax), for the half-year ending June 30th, £19,966 2s. 11d. = £48,488 12s. 8d. And it is proposed to appropriate the balance as follows:—Final dividend for half-year at the rate of 9½ per cent. per annum (subject to income-tax), £22,265 12s. 6d.; addition to reserve for contingencies fund, £10,000; and to carry the sum remaining to electrical renewals fund, £1,262 14s. 11d., £11,462 14s. 11d. = £33,528 7s. 5d.; making a total of £82,017 0s. 1d. The interest on investments, amounting to £2,795 11s. 5d., has also been carried to the credit of the contingencies fund. The reserve funds will now amount to £119,319 8s. 1d. The investments have been increased during the year from £80,122, at which they stood on December 31st, 1901, to £104,413 3s. 7d. The receipts from the tramways department show the substantial increase of £9,101, and those of the carriage department an increase of £3,627. The total number of passengers carried during the year on the company's cars and omnibuses was 41,194,899. It is an interesting fact that this number is equivalent to 125 times the population of Bristol. The continued improvement in the returns from every branch of the company's business affords ample evidence of the increasing popularity of the services rendered to the public, whilst the additional profits earned during the year cannot fail to be satisfactory to the shareholders.

Dublin and Lucan Electric Railway Co.

The report for the half-year ended December 31st states that the total expenditure has been almost exactly the same as in the corresponding half of 1901, whilst the receipts show an increase of £118, received on account of passengers and goods. A small amount (£140) has been charged to capital during the half-year for a condensing pond at the electric generating station. This will lead to a reduced coal consumption. After providing for debenture interest there is a balance available of £1,122. Out of this it is recommended that a dividend at the rate of 5 per cent. per annum be paid on the preference shares, which will absorb £475, and that £300 be placed to reserve account, leaving a balance of £347 to carry forward to next half-year.

Blackheath and Greenwich District Electric Light Co.—The report for 1902 shows that the number of consumers is now 1,234, the gross receipts £14,334, the expenditure £6,978, and the net receipts £7,355. Debenture interest has taken £4,500, and 7 per cent. on the cumulative preference shares amounted to £103. £1,000 has been placed to depreciation, and £2,909 is carried forward.

Charing Cross and Strand Electricity Supply Corporation.—The directors recommend a dividend on their ordinary share capital, for the half-year ended December 31st, 1902, at the rate of 12 per cent. per annum, making with the interim dividend already distributed 10 per cent. for the year, and carrying forward £14,860.

British Electric Traction Co.—The directors have declared the half-yearly dividend on the 6 per cent. preference shares.

British Electric Transformer Manufacturing Co.—At a meeting of this company held on 3rd inst. a dividend for the half-year ended December 31st, 1902, at the rate of 10 per cent. per annum, together with a bonus of 2 per cent., was approved. Dividend warrants will be posted on 9th inst.

St. James's and Pall Mall Electric Light Co.—Dividend and bonus for the past year 14½ per cent.

STOCKS AND SHARES.

Wednesday Evening.

What with the issue of dividends, reports, and other notices, shareholders in companies connected with electricity cannot complain of any lack of interesting items. The news, too, is generally favourable, and the course of prices reflects the cheerful feeling engendered thereby. Our list of electricity supply descriptions, for instance contains no single fall during the week, except a solitary case, which is caused by the marking of Kensington Debenture stock *ex* dividend. The telegraph market is far from being in equally happy case, but rails keep firm, while the miscellaneous varieties display little alteration.

The indisposition of his Majesty imparted a dull tone to Consols and other investment sections as a whole, but has failed to exert even a sentimental effect upon supply shares. No doubt this is largely owing to the fact that the companies continue to make such an excellent show in their dividends and reports. Westminsters are 10s. up, thanks to the advance in dividends. Charing Cross are also harder, despite the fact that the ridiculously wide official price remains the same. The Preference are being picked up for investment purposes, and so are London Electric Supply Preference, the price of which has improved 5s. South London Electrics have gained 10s. and it is understood that the company is about to declare its first dividend, which will probably be at the rate of 30s. per cent. Smithfield Ordinary retain their advance of last week, and the 4 per cent. Debenture stock shows a marked rise, especially as the quotation is now *ex* dividend. Blackheath and Greenwich are harder at 10s. buyers, a fraction more is really obtainable. One or two rises have also occurred in the gilt-edged list, so that altogether the electric supply market is very cheery. City of London shares, it may be observed, did not change upon the suggested arrangement with the City Corporation.

In the electric railway department City and South London Ordinary Stock has further improved upon its advance of last week, and the optimists go so far as to say that this security will assuredly get to par in course of time. Without subscribing unreservedly to such an enthusiastic dictum, it may be admitted that the market for the stock is a strong one, and there seems to be none too much of Ordinary about. The three Preferences will be quoted *ex* div. next Thursday, February 12th, in addition to the Ordinary stock. Central London issues keep firm, without material alteration; Great Northern and City Preferred "A" are 8, the meeting having no effect on the price; Waterloo and City changed hands the other day at par. Districts have risen sharply on the statements made as to the time when the electrification will be completed, and Metropolitan Consolidated has followed more leisurely in the same direction.

The glowing accounts of the Metropolitan Electric Tramways outlook which Mr. E. Garcke gave at the company's meeting the other day, are insufficient to help the shares from their present low values of 5s. and 20s. for the Ordinary and Preference respectively. Nor do British Electric Tractions display any recordable fluctuations, although business in them is pretty brisk. Bristol Tramways and Carriage shares have hardened a shade on the West of England exchanges on account of the capital report now presented to proprietors. The dividend for the whole of 1902 works out at 9 per cent., against 8½ per cent. paid in the previous twelvemonth. The £10 Ordinary shares stand at 20½, and the Preference are about 10⅝, the 4 per cent. debenture stock being 107½. None of these issues find a place in the London Official List.

Correspondents from West Australia speak well of the favour with which the Kalgoorlie electric tramways are being welcomed by those who can appreciate their value, and we hear that an important expense-saving development is under consideration by the Buenos Ayres and Belgrano tramway directors, which should, if found practicable, considerably enhance the value of the company's property. London United Trams Debenture stock can be bought about 105, and the Preference shares are 11½ middle. Cape Electric Trams are ¼ harder.

Telegraph stocks and shares remain dull by reason of forces which need no recital or reiteration. A fall of 2 points in Eastern Extension 4 per cent. Debenture is the most noteworthy feature, and the shares are 10s. lower. Commercial Cable Debenture has shed another 1 per cent, and Western Telegraph shares followed up their last week's fall of 5s. by one of £1 this week. Globe Ordinary, allowing for the dividend, are 3s. 3d. easier, but the Preference, *ex* 3s. a share, has not been altered. West India and Panama have regained their trifling loss.

Apparently the demand for National Telephone stocks has spent its present force, and the Deferred marks a 2 per cent. relapse. Orientals and Monte Videos keep idly firm. Electric Constructions are a better market so far as the shares are concerned, but the Debenture stock has cast off its recent 2-point rise. British Insulated Wire Preference are ¼ down, the miscellaneous section, as a whole, being somewhat lifeless.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Jan. 28th.	Closing Quotations Feb. 4th.	Business done week ended Feb. 4th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	96 —100	96 —100	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6ls.	60/6	47 — 50	47 — 50	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	89 — 91	90½	89½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7¾— 8¼	7¾— 8¼	8¼	7⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4 — 4½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —180	170 —180	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	91 — 94	90 — 93	92	90
16,000	Cuba Telegraph	10	4½%	4 %	..	5 — 6	5 — 6	..	..
6,000	Do. 10 % Pref.	10	..	..	..	13 — 14	13 — 14	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	..	2¾— 3¼	2¾— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10½	10 — 10½	10⅛	..
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	112 —117	113 —117	114	112
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	85 — 88	84 — 87	85½	84
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106½	105
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10¾— 11¼	10¾— 11¼	11	10⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	107 —110	107 —110	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102 %	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	..	8¼— 8¾	8 — 8¼ xd	8⅜	8
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13	12 — 13 xd	12⅛	11¾
150,000	Great Northern Telegraph, of Copenhagen	15	15 %	15 %	..	24 — 26	23 — 25	23½	23½
66,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	..	..	..	¾— ⅞	¾— ⅞	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	1— 1	1— 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	..	97 — 99	97 — 99	98⅜	97
1,966,667	Do. do. Def. Stock	100	60	64 xd	..	72 — 74	70 — 72	72	71½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	..	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	..	11½— 12½	11½— 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	..	5 — 5½	5 — 5½	5⅜	5⅛
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	..	94 — 96	94 — 96	94½	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	101 —103	101 —103	101	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	¾— 1	¾— 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	105 —115	110 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5 — 5½	5 — 5½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5	4¾— 5	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	100 —103	100 —103	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	10¾— 11¼	10 — 11	10⅜	10
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	..	..
88,321	West India and Panama Telegraph	10	½%	..	..	⅜— ⅝	⅜— ⅝	⅜	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4¾— 5¼	4¾— 5¼	5⅛	4¾
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	98	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	5¼%	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13 — 13½	13 — 13½	13½	13½
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	12 — 12½	12⅝	12⅞
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126	125⅛
100,000	British Insulated Wire Ord.	5	15 %	10 %	..	7¾— 8	7¾— 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6¼	5¾— 6 xd	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	103 —107	102 —106	..	..
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	8 %	..	..	12/6 to 13/6	12/6 to 13/6	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	15/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	..	¾— 1¼	¾— 1¼	¾	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	..	1 — 1¼	1 — 1¼	1⅛	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	91 — 96	91 — 96	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	14 — 15	14 — 15	14½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	6	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	108 —111	108 —111	110¾	109½
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	105 —108	105 —108	107½	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	113 —116	113 —116	114	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	76½— 77½	77½— 78½	78½	77
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2¾— 3	2¾— 3	2⅞	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —106 %	101 —106%	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	..	..	⅜— ½	⅜— ½	⅜	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	..	..	1¾— 2¼	1¾— 2¼	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 78	74 — 78	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1¾— 2	1¾— 2 xd	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¼— 2¾	2¼— 3	2⅛	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	97 —100	99½	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	..	16 — 17	16 — 17	16	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5¼— 5⅝	5¼— 5⅝	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	109½	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19 — 20	19⅜	19
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	101 —104	103	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	..	5⅜— 6	5⅜— 6	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅜— 10⅝	10⅜— 10⅝	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14¼— 15¼	14¼— 15¼	..	..
	§Rosling & Fynn 6 % Cum. Pref.	£1	6 %	..	..	.. ..	∞½ ..	..	..
87,250	Telegraph Construction and Maintenance	12	17½%	20 %	..	37 — 40	37 — 40	39	38
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	..	..

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.

‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, ½—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Jan. 28th.	Closing Quotations Feb. 4th.	Business done week ended Feb. 4th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	⅜ — ⅝	⅜ — ⅝	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	113 —116	110 —113	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	..	10⅜ — 10⅝	10⅜ — 10⅝	10⅝	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10 — 10¼	10 — 10¼	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9¾ — 10	9¾ — 10	9⅞	9⅞
70,000	Do. do. 4½% Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4¾ — 5¼	4¾ — 5¼	5	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	104½	104⅜
44,436	*Chelsea Electricity Supply, Ord.	5	5⅝%	4 %	..	5 — 5⅛	5⅛ — 5⅜	5⅜	5⅛
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	..	10 — 11	10 — 11	10⅜	10 2/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13½ — 14½	13½ — 14½	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	122 —127	122 —127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104½	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	..	8½ — 9½	8½ — 9½	8⅝	..
20,000	Do. do. 6 % Pref., 40,001—60,000..	10	6 %	..	..	12 — 13	12 — 13	12 5/16	12⅜
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	107 —110	108 —111	110	108
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7	6½ — 7 xd	⅞	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	6½	6½
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108 xd	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	..	10 — 11	10 — 11	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	100 —103 xd	..	..
110,000	ondon Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5⅛ — 5⅜	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	97 —100	97⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅔%	..	17 — 18	16⅞ — 17½	17 7/16	17½
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	107 —112	107 —112	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	..	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅔%	14⅔%	14⅔%	14⅜ — 15⅛	14⅜ — 15⅛	15	14 15/16
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	..	8⅝ — 9⅛	8⅝ — 9⅛	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	100	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	..	2⅛ — 2⅜	2 — 2⅛	..	..
50,000£	Do. do. 4% Deb.	100	..	..	..	80 — 90	80 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	..	3 — 3⅛	3⅛ — 4	3 15/16	3 15/16
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅝ — 5⅛	4⅝ — 5⅛	5	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅝ — 5⅛	4⅝ — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	11½ — 12⅛	12 — 13	12 11/16	12½
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛ xd	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 4th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ...	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19 10	£19 10	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	125/-	125/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	2½d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots ..	per ton	£148	£148	..
b ,, Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £130	£40 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	6¾d.	7¼d.	..
c ,, Wire, basis..	per lb.	6¾d.	7¼d.	..
c Copper Tubes (brazed)	per lb.	8¾d.	8¼d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¼d.	..
g Copper Bars (best selected ..	per ton	£67	£67	..

METALS, &c. (*continued*).				
g Copper Sheet	per ton	£67	£67	..
g ,, Rod	per ton	£67	£67	..
c ,, (Electrolytic) Bars ..	per ton	£59	£59	..
c ,, ,, Sheets ..	per ton	£73	£73	..
c ,, ,, Rod ..	per ton	£63	£63	..
c ,, ,, H.C. Wire	per lb.	7¼d.	7¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/7½	3/8 to 3/9	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	47/4½	47/6½	2d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 10 to £11 12 6	£11 12 6 to £11 15	2s. 6d. dec.
g ,, ,, Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 12 6	£8 12 6	..
d Mica (in ginal cases) small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11¼d. to 1/2	11¼d. to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars		From £15	to £40	..
g Tin, Block	per ton	£131 to £132	£133 to £134	£2 dec.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7½	1/7½	..
p White Anti-friction Metals—				
"White Ant" brand ..	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 1/16d.	4 1/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 10	£23 10	..

Quotations supplied by
- a Messrs. G. Boor & Co.
- b The British Aluminium Co., Ltd.
- c Messrs. Thos. Bolton & Sons., Ltd.
- d Messrs. F. Wiggins & Sons.
- e Messrs. Frederick Smith & Co.

Quotations supplied by
- f India-Rubber, G.P. and Teleg. Works
- g Messrs. James & Shakspeare. [Co., Ltd.
- h Messrs. Edward Till & Co.
- i Messrs. Bolling & Lowe.
- j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by
- k Messrs. Morris Ashby, Limited.
- m Messrs. W. T. Glover & Co., Ltd.
- n Messrs. P. Ormiston & Sons.
- o Messrs. Johnson, Matthey & Co., Ltd.
- p The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

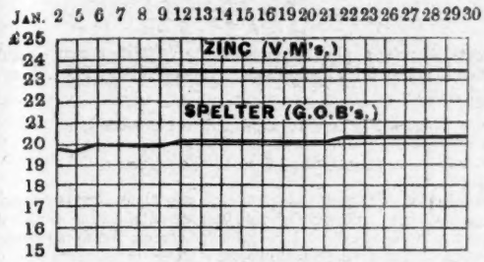
Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
Blackburn Corp. Trys. ..	Jan. 30	£ 653	£ + 79	£ 35,698	£ + 4,968	12¼	13¼
Blackpool and Fleetwood	,, 31	200	+ 55	825	+ 95	7½	7½
Bristol Trys. & Car. Co.	,, 30	4,196	+385	—	—	28	28
British Elec. Trac. Co.:—							
Barnsley District ..	,, 23	144	—	478	—	—	—
Devonport	,, 23	364	— 34	1,234	— 156	5	5
Dudley—Stourbridge..	,, 23	514	+ 1	2,090	+ 44	18½	18½
Gateshead	,, 22	756	+128	2,562	+ 440	10½	9½
Gravesend—Northfleet	,, 23	149	—	534	—	3½	—
Greenock—Pt. Glasgow	,, 23	353	— 15	1,294	+ 54	7½	7½
Hartlepool	,, 23	198	+ 28	695	+ 70	4½	4½
Kidderminster	,, 23	90	+ 4	309	+ 6	4½	4½
Merthyr	,, 23	153	— 38	510	— 104	5	5
Middleton	,, 19	207	—	728	—	8½	—
Oldham—Ashton ..	,, 23	492	+ 43	1,642	+ 99	8	8
Poole	,, 23	215	+ 40	690	+ 76	8½	8½
Potteries	,, 23	1,480	+133	4,720	+ 182	28½	28½
Rothesay..	,, 26	28	+ 2	147	+ 37	—	—

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
B.E.T. Co. (*continued*)—		£	£	£	£		
Southport	Jan. 23	184	+ 18	669	+ 263	5½	5½
South Staffordshire ..	,, 18	601	—102	2,042	— 318	21½	22½
Swansea	,, 26	397	— 13	1,411	+ 52	5½	5½
Taunton	,, 18	46	— 5	158	— 24	1½	—
Tynemouth	,, 23	182	— 7	614	— 28	8½	8½
Weston-super-Mare..	,, 21	19	—	67	—	2½	—
Wolverhampton Dist.	,, 23	301	+145	996	+ 583	10⅝	9⅝
Central London Railway	,, 31	7,004	+320	34,676	+ 1,796	6	6
City and S. London Ry.	Feb. 1	3,315	+294	16,993	+ 1,916	6½	6½
Doncaster Corp. Trys. ..	—	—	—	—	—	4	5½
Dover Corporation Trys.	Jan. 31	169	+ 5	773	— 40	3	3
Dublin United Trys. ..	,, 30	4,229	+426	17,900	+ 275	46	46
East Ham Tramways ..	,, 31	476	+181	15,681	+ 3,528	5	4½
Glasgow Corp. Trys. ..	,, 24	11,629	+989	415,909	+ 2,901	63	50½
Liverpool Overhead Ry.	Feb. 1	1,416	+144	7,309	+ 442	6½	6½
Newcastle Corp. Trys. ..	Jan. 31	3,055	—	—	—	35	—
Sunderland Corp. Trys.	Feb. 1	1,014	+ 93	—	—	17½	17½

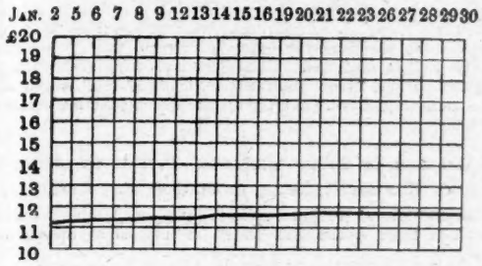
* Compared with the corresponding period of 1901.

METAL MARKET.

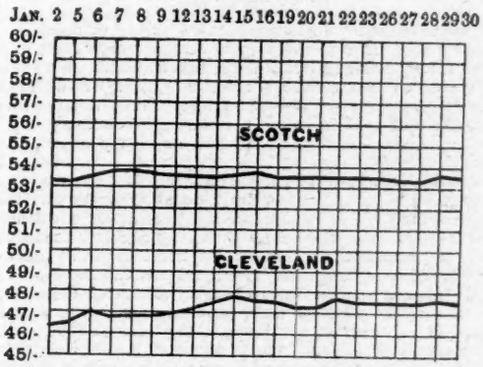
Fluctuations in January.



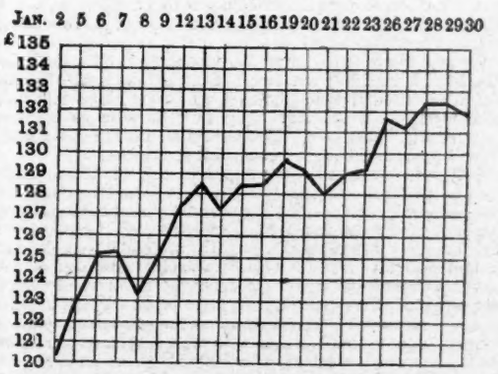
LEAD (ENGLISH).



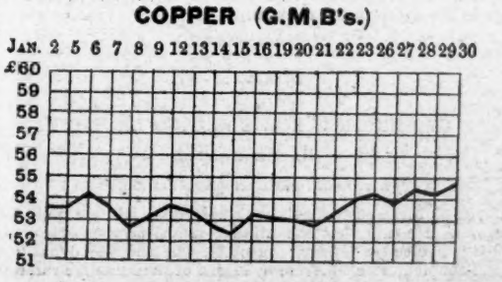
IRON.



TIN.



COPPER (G.M.B's.)



INSTITUTION OF ELECTRICAL ENGINEERS.

ON ELECTRONS.

By Sir Oliver Lodge, F.R.S., Vice-President.

(Paper read in London, November 27th, 1902.)

(Continued from page 119.)

PART III.

Determination of Speed and Electro-chemical Equivalent of Cathode Rays.

The curvature of path produced in cathode rays by a transverse magnetic field, or the amount of rotation produced by a longitudinal magnetic field, constitutes an evident mode of attacking the problem of estimating their velocity.

If the velocity is constant and the magnetic field uniform, the curve into which the beam is bent will be a circle, and its course can be readily traced either directly, after Crookes's manner, by letting it graze a phosphorescent substance, or indirectly by inference from the position of a linear target placed so as to catch the deflected rays.

Consequently there will be no difficulty in determining the radius of curvature r; and the theory is the simplest possible, nothing more than stating that the magnetic force H, acting on the current element $e\,u$, is the necessary deflecting or centripetal force, $m\,u^2/r$ required to overcome the mechanical inertia of the particles; *i.e.*,

$$\frac{m\,u^2}{r} = \mu\,e\,u\,\mathrm{H}, \text{ whence } \left(\frac{m}{e}\right) u = \mu\,\mathrm{H}\,r;$$

or the ratio e/m is to the velocity of the particles as the curvature of their path is to the intensity of magnetic field which curves it.

The two factors on the right of this equation are directly measureable (μ being conventionally ignored as usual, or, what is a better mode of expressing it, measuring H as induction density instead of as intensity of field), but the two factors on the left are both unknown, hence neither can be determined by this means alone: an assumption must be made about one or other of them, or else another independent kind of experiment must be made.

Assume, as many experimenters did, that u is a velocity appropriate to atoms flying in a gas of ordinary temperature, then the value of e/m comes out not so very far discrepant from the usual ionic value measured in liquid electrolysis, viz., 10^4 c.g.s. Or conversely, assume the usual ionic or electrolytic value for this ratio, and the cathode ray velocity comes out something quite appropriate to atoms of matter.

This, however, is a trap. These accidental coincidences may retard progress in a most serious manner, for they satisfy the mind and deter people from investigation. It is almost impossible to be completely on guard against them, and they are usually accepted until a more thorough qualitative acquaintance with the subject leads to an instinctive feeling that something is wrong somewhere.

So it was in this case, the long free path and the penetrating power of the cathode rays kept insisting that they were not really atoms of ordinary matter: a truth which both Lenard and Crookes had instinctively grasped, in spite of much criticism and valid arguments the other way; so in 1897 J. J. Thomson made a much more serious attack on the position.

He arranged that the magnet should deflect the rays into an insulated hollow vessel, connected with an electrometer and a known capacity, so that the aggregate charge of the cathode ray particles collected in a given time could be measured by the rise of potential observed. He also arranged that inside the hollow vessel they should fall upon a thermal junction of known heat capacity, connected by very thin wires to a galvanometer (acting therefore as a calorimeter), so as to measure their aggregate energy.

Thus he could make the following simultaneous determinations:—

$$\mathrm{N}\,e = \mathrm{Q}$$
$$\mathrm{N}\tfrac{1}{2}\,m\,u^2 = \mathrm{W}$$
$$\frac{m}{e}\,u = \mu\,\mathrm{H}\,r.$$

In these three equations there are four unknown quantities, but one pair can be treated as a ratio, and another, N, can be eliminated, and thus we get—

$$u = \frac{2\,\mathrm{W}}{\mathrm{Q}\,\mathrm{H}\,r}$$

$$m/e = \frac{\mathrm{Q}}{2\,\mathrm{W}}\,(\mu\,\mathrm{H}\,r)^2.$$

When these brilliant measurements were actually made in the laboratory the material nature of cathode rays was, if not actually disproved, at all events rendered highly improbable; for their speed was found to be of the order 10,000 miles per second, or even as high as $\frac{1}{10}$ that of light in a favourable case, being always of the order 10^9 c.g.s., while the electro-chemical equivalent was of the order 10^{-7} c.g.s., or about $\frac{1}{10^4}$th that of hydrogen.

Changing the kind of residual gas in the tube, and changing the electrodes, made no difference to this last value. *The cathode rays were evidently independent of the nature of the matter present:* an exceedingly momentous fact. If they were matter at all, they appeared to be matter of some fundamental kind independent of the distinctions of ordinary chemistry. Their velocity, however, depended on the potential difference between the electrodes, in a way that suggested that they were really projectiles urged by the

potential gradient acting along a given length of path. They were propelled by the cathode through an aperture in the anode, and the measurement of their speed was made in the tube beyond the anode, where they were travelling by their own momentum. The distance apart of anode and cathode did not, and on the projectile hypothesis ought not to, affect this speed; for though the potential gradient is steeper when anode and cathode are put close together, the length of path during which the particles are subject to it is diminished by a compensating amount, so that the velocity is theoretically independent of the distance between the electrodes, as long as the total difference of potential is maintained; it is the absolute difference of potential that determines the speed. But manifestly if the electrodes are too close together it may be difficult to secure a high difference of potential between anode and cathode, since they may spark into each other outside the tube; and if there is much residual gas in the tube it will likewise be difficult to maintain a high potential difference, because that residual gas, under the influence of the cathode rays, will conduct. Consequently the best speeds are obtained at high vacuum; and if the density of the residual gas inside the tube is constant, the speeds will be constant. The nature of the electrodes makes no difference, unless they give off gas or otherwise make it difficult to maintain the required potential difference.

Although the speed of the particles in cathode rays was thus found excessively great, their energy was only moderate, and their aggregate mass therefore excessively minute; their aggregate electric charge, however, was considerable. They were able to raise an electrical capacity of 1·5 microfarads several volts, sometimes as much as 20 volts, in the course of a second; and in the same time they might be able to raise a calorimeter, whose heat capacity was about 4 milligrams of water, by 2° C. Nevertheless their mass was so small that it would have taken 100 years to collect a weighable amount, and then only about one-thirtieth part of a milligram. They travelled with a velocity 100,000 times greater than the speed of rifle bullets, and represented the greatest velocity up to that time observed or even now known in matter, if matter they were; and the electro-chemical equivalent, instead of coming out in accordance with that observed in liquids, came out some 1,000 times smaller; that is to say, the charge associated with each particle of the cathode rays seemed 1,000 times greater in proportion to the mass than the charge associated with an electrolytic ion, even of hydrogen.

If the flying particles were really atoms, there was no escape from the certainty that they were extraordinarily highly charged atoms; but if, as seemed more likely to the instinct of most of those who worked at the subject, the charge on the flying particles was the same as the charge possessed by an atom in electrolysis, then, assuming that the experiments were correct and correctly interpreted, there would be no escape from the conclusion that the mass associated with the ionic charge in cathode rays must be a thousand times smaller than the mass of a hydrogen atom; in which case the cathode projectiles might conceivably be the detached and hitherto hypothetical individual electrons or atoms of electricity themselves. It would be extremely rash, however, to jump to such a far-reaching conclusion on such comparatively scant evidence. The evidence must be confirmed by other departments of Physics or by other determinations based on a different method; and they must be further scrutinised in the light of the magnetised radiation phenomenon observed by Prof. Zeeman of Amsterdam. We will first describe a determination made by another method, and then some striking measurements applied to phenomena which belong apparently to other departments of Physics.

Further Measurements of Cathode Ray Velocity and m/e Ratio by Aid of Electrostatic Deflection.

Another and perhaps simpler method of determining the two quantities u and m/e was also employed by J. J. Thomson, viz, by deflecting the same rays both electrostatically and magnetically; by introducing a pair of supplementary electrodes, one above and one below the course of the rays inside the vacuum tube, and connecting them to the poles of a low potential battery, a few storage cells for instance, thus obtaining a vertical electrostatic field at right angles to the cathode rays. At the same time a magnetic field, produced by lateral magnet poles or by the lines of force due to an electric current in a circular ring, could be arranged at right angles to both the other directions; and thus the electrostatic deflection could be compared with, or used to neutralise, the magnetic deflection.

Let the cathode rays be received upon a needle-point covered with phosphorescent material and movable up and down in a measured manner; then the deflection of the rays can be observed by reading how much the needle has to be moved in order to catch a narrow beam which has travelled through a length l of either an electric field of strength E, or a magnetic field of strength H.

If u is the original velocity of the ray particles, travelling at right angles to both the deflecting fields, either of them will have a time l/u in which to act; and in that time an extra component w will be caused in the direction of the electric force, or perpendicular to the direction of the magnetic force, such that the rate of change of momentum of each particle will be $\frac{m\,w}{l/u} = \mathrm{E}\,e$ in the one case, and $= \mu\,\mathrm{H}\,e\,u$ in the other; wherefore the deflection will be—

$$\theta = \frac{w}{u} = \frac{e}{m} \cdot \frac{\mathrm{E}\,l}{u^2} \text{ in the one case,}$$

$$\text{and } = \frac{e}{m} \frac{\mu\,\mathrm{H}\,l}{u} \text{ in the other.}$$

Hence if in the actual experiments the two kinds of deflection be made *equal*, by adjusting the relative proportion of the two fields, we get simply—

$$u = \frac{\mathrm{E}}{\mu\,\mathrm{H}}$$

$$\text{and } \frac{m}{e} = \frac{l\,\mu^2\,\mathrm{H}^2}{\theta\,\mathrm{E}}.$$

This method, when applicable, appears to give fairly accurate results; and the outcome of the measurements is that when H or CO_2 or air is in the tube—

$$u = 2 \text{ or } 3 \times 10^9 \text{ centimetres per second,}$$

$$\text{and } \frac{m}{e} = \text{from } 1{\cdot}1 \text{ to } 1{\cdot}5 \times 10^{-7} \text{ c.g.s. units.}$$

The chief difficulty about this mode of experimenting is caused by the fact that the ionisation of residual air in the tube causes it to become a temporary conductor, and so to screen the flying particles from most of the electrical influence. There is no guarantee that they feel the full effect of the electric field which is ostensibly being applied; indeed it is not easy to let them feel any of the effect. It used to be thought that they were not susceptible to electrostatic action at all, and this was often adduced as an obvious argument against their being electrically charged particles; but fortunately Thomson soon surmised the cause of this masking of the simple effect to be expected, and succeeded in showing that with high enough vacua and other precautions the screening ionised atmosphere could be removed, and the electrostatic deflection metrically observed.

Determination of Electro-chemical Equivalent in the Case of Electric Leakage in Ultra-Violet Light.

The same ratio of $m:e$, or a ratio of quite comparable magnitude, is obtained from phenomena which at first sight appear to be distinct.

One of these phenomena is the effect of ultra-violet light in discharging negative electricity from a clean metal or other surface; a phenomenon the investigation of which was begun by Hertz, and continued especially by Righi and by Elster and Geitel. (See one of the appendices to "Signalling without Wires," published by the *Electrician* Co.) If ultra-violet light, whether from a spark or from a flame, fall upon a negatively electrified surface, then in general there will be a leak of electricity from that surface, which electricity can be received by any body placed opposite the illuminated one, and can be used to charge an electrometer of known capacity, and so be measured. The writer has made very many experiments in this subject, which, however, have not yet been published. Now Elster and Geitel made the notable discovery that the introduction of a magnet affected the rate of leak, according to the direction of its lines of force. This phenomenon suggested a magnetic deflection of the lines of leak, which were shown by Righi to be singularly definite trajectories, and indicated that the leakage was due to the bodily propulsion of negatively electrified particles analogous to the cathode rays. A vacuum is not necessary to observe the effect, but in a vacuum the effect is more prominent and more accurately measurable. The difference between this case and an ordinary vacuum tube case is that there is no great E.M.F. or gradient of potential applied, there is accordingly nothing of the nature of a disruptive discharge; and in fact there is no leak at all until by the stimulus of the presumably synchronous vibrations of ultra-violet light the molecules are thrown into a state of agitation, and the attachment of the negative charge, or of some negatively charged corpuscles, thereby loosened.

Two things are necessary to get the particles away from the plate; they must be loosened by the impact of ultra-violet light—the direction of polarisation of this light having a very decided influence—and the surface to which they cling must likewise be negatively charged, so as to repel them. Neither light alone nor electrification alone will produce the effect; co-operation is necessary.

J. J. Thomson devised a most ingenious method of carrying out this experiment in a metrical manner, and of deducing from it the electro-chemical equivalent of the charged particles, that is to say, the amount of matter which each contained compared with the electric charge which each carried. To this end he employed the usual arrangement of a small negatively charged zinc plate on which ultra-violet light from a distant arc lamp could shine, through quartz, and also through a parallel piece of wire gauze connected with an electrometer. The distance between the zinc plate and the metallic gauze was variable, and the experiment consisted in observing how much electricity reached the gauze from the negatively charged plate, under the influence of light, first without, and then with, a magnetic field of measured strength applied crossways to the region between them.

(To be continued.)

GAS ENGINES FOR ELECTRIC LIGHTING.

By Mr. Graham.

(Paper read at the Birmingham Local Section.)

In opening his paper the author explained that it was quite unpretentious. He said that the ordinary industrial type of gas engine failed for electric lighting purposes, whether the dynamo were direct-coupled or belt-driven, by reason of the excessive variation of speed between full and half loads.

For continuous-current generators, the gas engine could be so modified as to give perfectly satisfactory results, but for alternating currents no gas engine had yet been designed—so far as was common knowledge—which could be said to give even moderately satisfactory results, and the uneconomical expedient of driving gas engines in parallel had to be resorted to in such cases. The requirements were very exacting, the limit being a variation of speed of only one-half per cent. under varying loads.

In the ordinary gas engines the speed variation might be 7½ per cent., and yet be unnoticeable by reason of the reduction of speed through the secondary and tertiary motion shafts, but in engines supplied for electric lighting purposes—he then spoke of continuous current plants—such a variation would tend to largely increase the amount of acrid correspondence addressed to the engine makers.

With a reasonable increase of speed between engine and dynamo, if belt-driven, or by an efficient elastic coupling, if direct-coupled, the speed variation might be kept within 1½ to 2 per cent., and under the maximum limit the lights would appear quite steady and might be considered satisfactory.

In adapting an industrial type of gas engine for electric lighting purposes, the designer naturally first attacked the fly-wheel problem. He would find that the fly-wheels were usually too light or too small in diameter, either conclusion amounting of course to the same thing as the other.

The diameter of the fly-wheels on an ordinary gas engine had been usually a matter of convenience more than one of calculation. The distance between the centre of the crankshaft and the ground line, made up usually by the cast-iron bedplate resting on a slab of stone placed on the top of the concrete foundation, was sufficient to afford easy access to the parts under the cylinder jacket such as the exhaust valve, exhaust valve adjustable spring shackle and relief water cock (the latter for use in frosty weather). Unless two wheel pits be sunk (in which practice there was an element of danger) the diameter of the fly-wheels was, therefore, fixed by other details of design, allowance being made for a clearance of about 1 in. between the periphery of the wheel and the floor.

For electric lighting purposes it was necessary (1) to increase the weight of metal in the rims of the wheels; or (2) to increase the diameter of the wheels; or (3) to increase both weight and diameters in moderation.

To increase the diameters alone would be the most preferable method since the weight required in the rims varies inversely as the square of the diameter, but this enlarging of the wheels was checked by the periphery safe velocity limit before a sufficient increase was attained. To increase alone the weight of the rims would be to also increase the cost considerably, and at the same time decrease the mechanical efficiency of the engine by the increased inertia to be overcome. The most convenient method was, therefore, to increase the diameter of the wheels until the periphery of each attained a velocity of 85 ft. per second, and then to add the required weight to the rims. In practice, however, it was found that the addition of weight to the wheels necessitated a crankshaft of stronger proportions, which again required larger bearing surfaces in the journals. With new wheels, new crankshaft, new brasses, and in consequence a new bedplate, the ordinary gas engine was, to all intents and purposes, a new engine, and it was doubtful whether it would not be cheaper and better to re-design the engine altogether from another standpoint. Having perforce to resort to the wheel pits, there was no longer any strong incentive to keep the two fly-wheels, and so in practice it was found preferable to build engines for this purpose with only one large and heavy fly-wheel, the additional bearing surface being provided by an extra bearing in the pedestal form. The most suitable arrangement was for the fly-wheel and pit to be placed on the left-hand side of the engine, thus removing a source of danger to the attendant, who was entirely occupied with the right hand or lay shaft side, whereon are to be found the timing valve, speed governor, main lubricators, self-starter, half compression lever, and all cams and rollers. The second point of difference between the low and high speed engine is in the form of balancing the crank and connecting rod. On the low speed engine the counterbalance is invariably cast under the rim of fly-wheel, but for accurate balancing this method cannot be considered as efficient as the direct counterbalance studded to the crank web, and rotating at the same radius as the crank pin, the centre of the weight to be counterbalanced.

In hotels, private houses, hospitals, and even in many business concerns, comparatively undisturbed silence is a desideratum. For this reason it was not always advisable to rely on air silencers and—patent or otherwise—exhaust mufflers, but it was better to place the engine, and, in fact, any machinery, in a separate out building. In such cases the main gas cock in the outbuilding might be operated from the main building by a switch, the details of which were then described.

The arrangement obviated a regular visit every evening to turn off the gas, but the ignition apparatus as usually fitted on gas engines was still a source of possible annoyance. He did not say a regular source of annoyance, for such was not the case, but whether a common iron ignition tube, a Hacknum metal ignition tube, or a fireclay or porcelain tube were used, one was always subject to their failing at an unexpected moment. Notwithstanding its occasional failings, the fireclay or porcelain tube was, for many reasons, the most satisfactory. It could be heated sufficiently to fire the initial charge in less than two minutes, only requires 2 to 3 cb. ft. of gas per hour passed through a Bunsen burner to remain incandescent, and two out of three would last for months with fair treatment, but even its warmest admirer must confess that it was liable to end its career without a moment's warning, and so he went back to the occasional failure which might occur at an extremely trying time. To prevent these stoppages, it occurred to him that the tube might at the very moment of ending its career at least perform one parting act of grace before reaching its final stage of disintegration. In brief, the engine was fitted with an electric sparking ignition plug as an emergency standby. The porcelain ignition tube supported a lever, on the collapse of the porcelain tube the lever fell through an arc of 15°, and in doing so drew over a switch and completed the emergency circuit, and the engine continued as before, only the form of ignition being changed. The lever in falling also dropped an ignition valve retainer, which kept this valve on its seat, and so prevented a leakage which would otherwise have been sufficient to cause the engine to stop if under full load at the time, and turn out the Bunsen burner. It also performed a third function in starting an alarm bell placed in a convenient spot in the house, which might be of course immediately switched out of circuit, but not before it had given its message from the engine room. The apparatus was placed on the table for inspection at the meeting.

He thought it to be unnecessary to say that no reciprocating bearing should be fitted to an engine without some means of adjustment to compensate for wear. Yet it must be confessed that few gas engine makers consider it necessary in the case of the cross-head pin. He spoke of the pin connecting the small end of the connecting rod to the piston, the whole force of the explosion was borne by this pin, and a bump was bound sooner or later to be heard, generally after the short guarantee had expired, and a new pin was then necessary. The splitting of the pin and the insertion of a piece of a paper as packing he rejected as an unmechanical means of adjusting a machine, besides lowering the strength of the pin itself. If it were argued that the pin was twice the necessary strength before being split, it was evident that the piston was unnecessarily weighted by such a design. This detail was of particular importance to electric light machines, because as the jar at each explosion was far more likely to cause annoyance to their purchasers than would be the case with engines employed to work a Massey hammer or a battery of stamping machines.

Much annoyance was often caused on engines required to run long hours without attention, by the faulty design, or bad arrangement of the automatic lubricators. It is surprising that the revolving dipper type of mechanical lubricator has enjoyed such widespread—almost universal adoption—for it cannot be considered either an economical or even moderately able serviter. In the first place, if it were more than half filled, the oil would find its way through the lubricator crankshaft bearing and trickle down the belt working from the cam shaft on to the lubricator pulley, and if too generously filled, it would entirely empty itself, siphon like. In the second place, when it was half filled to its safe limit, it delivered an all but constant stream of lubricant, but as the level of oil in the basin became lower and lower, so the quantity of lubricant became less and less, and it followed that it either delivered a great deal too much when first started after replenishment, or else a great deal too little when the oil became low in the basin. The other lubricator on the table showed a method which he considered superior to that just described. Instead of a crank at the end of the shaft, a cam was fitted. The shaft bearing was, therefore, capable of being put at the top of the basin, and a basin of the same size would therefore contain a third more storage in the latter than in the former. The cam at the end of the shaft raised a valve, and the lift of the valve was adjustable to suit the speed and proportion of working strokes of the engine. The quantity of oil passed was exactly the same whether the basin were nearly full or nearly empty.

Mr. Graham then turned to a very important point, viz., the gas consumed per horse-power-hour. It had often happened that a moderate priced engine with a guaranteed gas consumption of 16·5 cb. ft. per brake-horse-power had been rejected in favour of one 20 per cent. dearer with a gas consumption of half a cubic foot less per brake-horse-power, without ascertaining the fact that the first guarantee was on a gas of about 550 B.Th.U., while the latter was on a gas of 700 B.Th.U. The advantage was, of course, entirely on the side of the moderate priced engine. The engineer who made the selection was not seriously to blame for the error he made, judging him in comparison with his class. He could not implicity accept the statements of either of the rival engine makers, for both unreservedly denied and contradicted all that the other had said—as was their usual foolish way. He could not learn much from the gas department for they were unwilling to give the information desired. This was not a small matter, but one of the greatest importance to gas engine users, whether the engines were used to provide the motive power for generating electric light, or were employed to drive machinery of another kind, and yet the consumers using the coal-gas as fuel more than an illuminant, are content with the knowledge that the gas was of about 16-c.p. As they were well aware, the photometric value of a gas bore no fixed relation to the califoric value of a gas. Two gases both of 16 candle (illuminating) power might be capable of differing as much as 25 per cent. in their respective average calorific (heating) powers, but this was not all, for gas taken from the same mains might vary another 25 per cent. within a few hours. A gas of 14 c.p. might be equal for use in an internal combustion engine to a gas of 17 c.p.

Considering the large number of gas engine users in every manufacturing town, it was most surprising that in a supposedly scientific age, the calorific value of municipal gases did not receive more attention that was actually devoted to it.

The matter was one of the utmost importance to electrical engineers, because the price per electrical unit thus generated depended mainly upon the price per calorie consumed in the prime mover. Some day the consumer would awaken to this fact, and a calorific standard would be insisted upon instead of the present photometric standard.

Some stinging remarks concerning the quality and price of Birmingham gas were then made by the author, who drew comparisons between it and Manchester City gas. Whereas the latter cost 2s. per 1,000 cb. ft., in Birmingham they had to pay 2s. 3d., while there was a difference of calorific value of 25 per cent. in favour of Manchester. These figures were sufficient to show that the state of affairs in Birmingham was far from satisfactory, and he hoped that the engineers present would note them.

A description of Junker's calorimeter and Mathot's indicator then followed, and numerous diagrams and slides of small gas engines used for electric lighting purposes were shown.

DISCUSSION.

The discussion was opened by Mr HENRY LEA, the chairman. He thought that Mr. Graham was rather contradictory at times. He (Mr. Lea) had found no difficulty with the gas engine when proper fly-wheel arrangements were made, and he failed to follow the author in the allusions to fly-wheel proportions. He cited the case of a Westinghouse gas engine in the district driving an alternator satisfactorily, and thought that gas engine makers must follow the example of some engineers and build vertical gas engines. He suggested the fly-wheel of the disc pattern, which was lighter and cheaper than the ordinary wheel, giving the same momentum and requiring no outer bearing. He was glad to see the speeds increased, and thought that was a line of development. As for the author's remarks about noise of exhaust gases he (Mr. Lea) had fixed six exhaust boxes as fitted by Crossley Bros., so that the gas came out at right angles in each box to the admission pipe, and found it most effective. For small plant it was an axiom to put in a storage battery, and therefore there was no need for obtaining switch devices for shutting down at night if the engine were in an outhouse. Batteries were highly objectionable, but they were also very necessary evils for small lighting plants. He advocated electrical ignition and the abandonment of the porcelain tube altogether. Mr Graham's remarks about revolving dippers did not at all agree with his experience of them. He attributed the fall in calorific value of Birmingham gas to the introduction of water gas, and gas engine users were only getting about 93 per cent. of power for the same money that they used to pay before water gas was introduced. It was most important to state the calorific value of the gas used when tendering for an engine.

Prof. BURSTALL said that he thought Mr. Graham would not mind him saying that he had heard a good deal about many things that evening, but not much about gas engines for electric lighting. Perhaps the author had assumed that the construction of such engine was perfectly well known to all present. As for the statement that little improvement had been made in the last year, he (Prof. Burstall) had learned more in the last year than ever he had for many years before. Immense progress had been made, and they knew a good deal more now than previously. For example, the introduction of the Körting, the Westinghouse, the great engines of Deutz and John Cockerill had all come on immensely in the last two or three years, while in this country, several very large engines had been put up and a great amount of experience had been obtained The really interesting problem for the future was the construction of medium engines from 40 to 200 H.P. and from 250 to 1,000 H.P. for electric lighting. He had recently seen plans for a 1,000 H.P., and one well-known firm was prepared to guarantee an engine of 2,000 H.P. All of these were for electric work, and embodied many principles not found in small engines. The introduction of the multi-cylinders for power above 250 H.P. was in order to get better speed regulation. If gas engine makers wished to obtain any share of the work from consulting engineers for central stations, they must use four-cylinder engines to give nearly an even turning moment. No engineer would look at a large engine unless he were confident that the speed regulations did not depend upon the fly-wheel. In the larger sizes it was necessary to water-cool the exhaust valves. Electric ignition was compulsory, the principle being that called the magneto; the igniter points being soft iron, fresh points could be put in without stopping the engine. In that way a large engine had been made to run for 80 days without stopping.

Mr. J. C. VAUDREY was rather disappointed with the paper. He had hoped to hear more about the large power gas engine, and there was no doubt that there was a field for this type of engine for large power stations. He hoped that they would have a paper on this subject later in the session.

Mr. CLOUGH spoke of the evil effect of the synchronising current surging between alternators, and in this respect gas engines, which were always provided with very large fly-wheels to overcome the initial variation in the impulse, had the advantage that the secondary variation due to the synchronising currents was proportionately very much smaller. He gave figures to prove his case, and said that the fact of the synchronising current flowing between two alternators, instead of improving the conditions, had a detrimental effect, which seemed rather a paradox, but was a fact.

Mr. BATE suggested two ways in which it was possible, even with small engines, to do with comparatively light fly-wheels for parallel running, although he could not speak from experience as to whether they were effective. One was that of regulating the voltage of a gas-driven dynamo by inserting resistances automatically into the shunt circuit at the moment, or immediately before the moment of every explosion. By careful experimenting it would be possible to time the movement of the resistance lever so that the volts of the dynamo were reduced just when the increase of speed would have sent them up. Another way—but he knew it was open to very serious criticism—but still it was possible for a small power at any rate, was in the same direction in which large steam engines had been developed, namely, by increasing the speed, and not merely increasing the number of cylinders, but by going up to such speeds as were in use in motor-cars. This would enable a very small dynamo with a large number of cycles per minute to be used and the cyclic irregularity would be of very little importance. There would be heavy wear and tear, but the first cost of the engine and dynamo would be very much less, as would that of cleansing and repairing. He knew one such plant had been put in by Messrs. Mavor and Coulson.

Mr. WHITTAKER asked if at the Metropolitan Carriage Works there were two or three engines and alternators, and if the alternators were coupled in parallel. The difficulties at present in getting the explosions of the engines at exactly the same moment were very great, and there were considerable hunting currents passing from one alternator to another.

Mr. C. A. SMITH said that he had seen the engines working at the Metropolitan Carriage Works in parallel, and he believed that it was done by means of a flexible coupling between the engine and dynamo. Apparently, as far as he could judge from an hour's inspection, the engines ran perfectly well under a varying load, and they were of the Westinghouse vertical type. It was a matter of satisfaction to know that Messrs. Richardson & Westgarth were quite willing to quote for, and guarantee gas engines of the two-cylinder tandem type up to 2,500 H.P., to drive alternators in parallel, and by coupling two of these engines together with four cylinders on to the same shaft with the alternator between them, 5,000 H.P. could be developed in one unit. Mr. Graham had really dealt only with the small gas engine, but judging from the reports of the technical press concerning the Diesel oil engine since power could be developed at a running cost of one tenth of 1d. per B.H.P., he thought that gas engine makers must look for a harvest with bigger engines. No doubt in a short time central stations for generating power would use the gas to be provided by the Mond Co., at 2d. per 1,000 cb. ft.

Mr. HUNT said that Prof. Burstall had suggested a 2 per cent. speed variation as the sort of thing required for improvements in running alternators. (This Prof Burstall contradicted.) Mr. Hunt, continuing, said that some of the Continental makers came somewhere in the neighbourhood of a quarter of 1 per cent. He asked if the tandem cylinder gas engines now being built were on the same principle as the old Griffin engine discarded from the Belfast station, and he presumed that additional means had been taken for dealing with the trouble with the piston rod. Prof. Burstall said that the engines referred to were worked on one connecting rod and improvements had been made to prevent the heating of the piston rod.

Mr. GRAHAM then replied. He had purposely not dealt with the larger engines. He hoped at a later date to be able to approach the subject, and he entirely agreed with everything that Prof. Burstall had said. At the present time a large factory was being put down very near Birmingham for manufacturing large gas engines. He agreed that electrical ignition was superior to any type, but the defect was to prevail upon people to accept this. They regarded electricity as a mysterious thing, and they could easily place in a tube if it broke, but refused to understand about electrical ignition. He thought that Birmingham people were getting even less than the 93 per cent value quoted by the chairman in comparison with what they got some years ago. It was questionable if they got 80 per cent.

The CHAIRMAN then called upon Dr. Morris to show the action of Nodon's patent electric valve, and made some remarks concerning a wonderful converter he had seen recently in London.

Dr. MORRIS, the hon. local secretary, brought to the notice of the meeting the Snowdon rectifier which we recently described.

Pipe-covering Tests.—The *Electrical World*, N.Y., abstracts a paper by Mr. H. G. Statt upon pipe-coverings, which explains a method of testing pipes electrically. A heavy current of electricity is sent through the pipe, and after a sufficient time has elapsed for steady conditions to be attained—about 10 hours—the energy lost in watts is measured for the tested sections. This energy obviously represents the rate of loss of heat which is always in progress from that section of pipe. The temperature of testing was 350° F., and a second series of tests was made with the current increased so as to give a rise of 50° F. to the least efficient covering. The readings were reduced to the basis of heat lost per square foot of pipe surface, and a considerable number of different coverings were tested, which gave an economy of 78 to 89 per cent. over bare pipes, according to thickness and material. The magnesia coverings appeared on the whole to be the best; they also appeared most regular in giving an increased economy, which varied with the square root of the thickness. Absolutely the best covering was carbonised silk. The conclusion to be drawn generally is that a good one-inch covering may lose about 2 B.Th.U. per square foot of pipe per minute, and about 1½ B.Th.U. for two-inch thickness. The figures may be equated with first cost, and the saving that is commercially possible may be estimated. Obviously for temporary work a covering must be thinner than when years of life are called for. The square-root rule points out that a limit of thickness is soon reached. It is shown that if a covering is guaranteed to last 10 years it will pay to put it on three inches thick, whereas for a two years' temporary plant a thickness of one inch need not be exceeded.

THE FUEL VALUE OF REFUSE.

By W. H. BOOTH.

The term "value" as applied to refuse when used as fuel has not a fixed meaning. All refuse has a value as fuel—that is to say, it is capable of being ignited by some initial source of heat, and it will then continue its combustion indefinitely. Ordinary garden refuse made into a pile with a core of dry straw will burn away entirely. In this case the central fire gives off enough heat to drive off the moisture in the form of steam from the next layer of the wet rubbish, which then burns and provides heat for a further drying of the next wet layer. The process of town refuse destruction is one that at present is looked upon as a sanitary necessity, and there is very little, or perhaps no, town refuse which does not contain a sufficient fuel value to complete its own destruction at a high temperature. Even if the products of combustion are somewhat cold, there is no reason why they should not be employed partially to heat up the material which enters the cells so that the temperature of combustion may be raised. The greater mass of material which passes through the furnace is the air which is used, and this is the portion of the "fuel" which should be heated if necessary. Looking upon destruction as a necessity, the utilisation of the surplus heat remains to be considered entirely from a commercial aspect. There is no occasion, or at least there should be no occasion, to withdraw clinker at 1,000° F. temperature if the heat it contains is thought worth saving. The specific heat of clinker and ash is about 0·2, so that a high temperature does not necessarily represent much heat. Still, if this ought to be economised, let the clinker be drawn off into a position where it will give up its heat to the incoming air. This very fact that clinker contains little heat also teaches us that the combustible part of refuse can be made to produce high temperatures so long as the heat which is generated is not taken up by surrounding objects.

If 1 lb. of refuse contains 3,000 B.Th.U. of calorific value, very little of this need be taken up by the clinker if cooled, as suggested, by the incoming air. The steam formed from the refuse is in itself valuable from the fact that it is probably more destructive of bacterial life than is dry gas of equal temperature.

Apart from the latent heat of the steam the refuse fuel has the following heat to give out or waste, on the basis of the figures given by Mr. Broadbent:—

3·5 lbs. of waste gas raised from 60° to 500°	=	355 B Th U.
30 per cent. clinker raised from 60° to 160°	=	6 „
30 per cent. moisture evaporated ...	=	290 „
Total	...	651 B.Th.U.

Thus 651 heat units are lost and the remainder are available for use.

As regards the air necessary for refuse combustion, this ought only to be about 18 lbs. per pound of combustible, so that the heat units generated are not spread over a greater mass of material in the case of refuse than in the case of coal, excepting alone the moisture from the rubbish; that is, the ash, gravel, and other non-consumable stuffs give back their heat. But the rubbish occupies so much space that very little combustible can be dealt with in a given furnace volume, and there is not much heat developed for immediate use.

It is difficult enough to burn good coal so completely that the heat of its combustion can be allowed to be absorbed by the furnace walls. Early destructors attempted to do this, for refuse was burned in boiler furnaces.

No success attended refuse combustion until this error was recognised, and firebrick cells of a non-heat-conducting material were employed. At once was seen of what refuse was capable, for apart from the heat absorbed by the steam, a refuse cell should be nearly as hot as a cell in which coal is burned. To put the two fuels on equal terms, it would be necessary to wet coal to the extent of from its own weight of water to double that amount.

The fuel value of refuse, regarded as a producer of heat, may, therefore, be looked on as about one-sixth that of coal, more or less, according to the quality of the refuse.

Taking a commercial view of the matter, we must begin beyond the destructor cell; that is, the destruction must come before the ledger. We must destroy the refuse absolutely, and to do so must build cells of firebrick. Sanitary considerations in this respect become the soundest commercial reasons. We may then turn the product over for utilisation, and only from the outlet of the destructor ought ordinary commercial considerations to intervene.

These considerations are to be based on the heat output on the one hand, and the cost of utilising this on the other. Having seen Shoreditch with its maze of boilers, and its high hen roost full of thermal storage vessels, the doubt arises whether the gain is worth the outlay of capital.

The matter would be very much simplified were there an all-day sale for electric current. No ordinary lighting station has such a sale, but it ought to be possible to sell current all day long to some electric railway, and at Shoreditch there is a tube line so near to the destructor that this solution is obvious, and if not adopted or thought of, is not creditable to the management of either railway or destructor. Assume that the railway purchase the current for a figure below what it costs them to produce it themselves, the vestry would have about 15 or 18 hours per day of a steady output, and it would be a simple matter then to calculate the annual cost in labour and interest, &c., necessary to produce this selling value. With the usual load factor of about 12 per cent. of an electric light station, it is obviously unlikely that such a plant as Shoreditch can show a commercial result. The thermal storage system is cumbersome. Thermal storage might be a success if steam could be stored in a small space, but hot water holds comparatively little heat and thermal storage vessels must be as strong as the boilers and costly.

So long as the ridiculous system of maximum demand rules the minds of electric light men, they can never expect to secure a day load of small power men. In the neighbourhood of Shoreditch there are thousands of small power users who would use little driblets of current all through the day if they could get it at a flat rate of, say, 2d. The load curve of many little users would give a steady station load. But the stationman goes to the small user and says: You are using your power very unsteadily, and you use 1 ampere-hour about three times a day, and this gives our 6,000-KW. station a bad load curve.

As a matter of fact, a few thousand of these small users would, combined, give a horizontal station load. But the stationman cannot see this, and the maximum-load lunacy goes on, and in place of a constant output we find thermal storage, and so on.

It is because of the ridiculous frills hung round electric supply that it has made such small progress. The public won't pay for what they consider is the electrical man's inability to engineer his business well. They get flat rates on gas, and use it as they like, and the multitude of irregular users gives the steady output.

Yet in electric supply the small workshop that would use power is asked to pay 8d. per unit for his daylight use of power, and the big shopkeepers, whose night use of current is the cause of bad station load factor, get off for 2d.

Electric stations are so greedy of their 8d. or 5d. for lighting current, that they look askance at the man who would use a steady current during daylight, and would thus cut down the peak of the evening load.

In short, while they cry out for a day load, they do everything to stop people from giving it to them, and until steady loads have been secured there will not be much prospect of successfully employing destructor heat, for destruction is a process that must be continuous, and rubbish must not be stored up, even if this could be done with success from an engineering aspect. It is sanitary malpractice.

Refuse has therefore a fuel value in proportion as it can be used steadily and continuously, and an electric light station is not the place to expect such use in the present state of thought of its managers and their belief in the maximum demand system. Such belief can only be based on the idea that every sewing machine, every sausage machine, lathe, drill, mangle, or other current user is put to work at the same time, and would, combined, produce a load curve of similar order at the station. The difference between a lighting load and a power load may be exemplified by

pointing out that all lighting stations, whatever their size, have the same bad load curve. A big station has no better curve than a small station. But in tramway work the big tramway of 500 cars has a load factor of 90 per cent.; the small station of five cars a factor of more nearly 19 per cent. In any power station a steady load curve and a high factor will accompany a multitude of users. The load factor of a single tramcar is perhaps 11 per cent., but the single car is not debited with current charges on this basis. It is debited with the cost of current produced on the basis of the station load factor. The ordinary power station load is similarly built up of a combination of many users of individual 10 per cent. factor only, and the maximum demand system is the folly that has grown out of that fact, which ought to be met on exactly opposite lines. The man who is wanted as a customer of a power station is the man who will use current like a tramcar, one minute 70 amperes, next minute, zero. A recognition of this fact by anyone with courage to act on it would make a success of electric lighting and power. There is a very poor prospect of success where seven-eighths of the power plant is idle most of the day. The same recognition would make a success of refuse destruction.

NOTES ON CENTRAL STATION WORKING.

By A STATION ENGINEER.

When the reasons for the existing low charges for electrical energy, as compared with those in vogue ten years ago, are considered broadly, the variety of experience gained in that comparatively short space of time points to the fact that improvements in design and economies in working of the plant have run hand in hand to bring about the reductions; so much so is it the case in districts where load factors run high that it is hard at first sight to foresee how the proportion of total working costs to revenue can be improved upon to any marked degree. It has occurred to the writer, who has had an intimate insight into central station practice and departments connected therewith for a number of years, that the guiding spirits of such enterprises, be they boards of directors, municipal committees, or other advisory bodies, are not sufficiently alive to the importance of urging the staff directly responsible for carrying out the duties of the business to do their level utmost individually to secure progress for the concern. The idea is by no means a new one, but it is undoubtedly the right method of appealing to the willing efforts of every human being engaged in the higher services of a corporate body.

The usual method of fixing a salary which bears progressive increments according to length of service or, as is too often the case, to no rule at all, simplifies the ledger entries in a most delightful manner, but it does not take into account whether there has been adequate return for such remuneration—so long as hard and fast rules are adhered to, the service is considered satisfactory.

The chief engineer of a central station of any magnitude can have only a superficial knowledge of the inner workings of each department under his control, and must rely to a very large extent upon the brains and energies of his subordinates for the best results; if these results do not come up to expectations, it is exceedingly hard for him to account for them individually, and in a comprehensive manner.

Boiler Room.—The economies which may accrue from systematic supervision in a central station are manifold, especially in the boiler room, where a lamentable lack of interest is often displayed; and yet it requires the most skilful generalship to raise steam economically under all loads; the boiler room is less clean than the engine room, and is left more to the tender mercies of a foreman than to an educated engineer. The former can do much in the manner of the handling of the working staff, which, in this department, is not always an easy matter, but it requires an educated head to reduce to a minimum the several losses which are always bound to be incurred in plant of this description unless remedied in time. Boilers, being the least efficient part of the generating plant, therefore require by far the most attention.

Engine Room.—A great deal of time and thought is bestowed upon the engine room and its adjuncts, because it is here that the attractive mysteries of electricity have full play for the staff in general; so long as the engines run round without knocking, the dynamos give their specified output, and the pounds of coal per unit are normal, all is well—the engines may be indicated at intervals, the switchboard instruments and energy meters checked occasionally, and in general, so long as the yearly results show a progressive improvement, the whole is pronounced to be satisfactory.

Mains.—The mains department has usually the brunt of the fight to bear in dealing with discrepancies which appear fitfully, requiring frequent and often immediate attention, while weak points are ever on the increase as the system grows.

Now, in giving a brief *résumé* of the routine of many a central station, one cannot make any hard and fast suggestion as to how the results, be they ever so good, can be materially improved by one or more responsible engineers, since local conditions and systems vary in almost every case; but it is strongly contended that every responsible member of the staff would take a much greater interest in his work, and put forward his highest efforts in the interests of his employers, if something more than a salary, varying more perhaps by luck than by just merit, were held out; the salary principle does not always do justice to the right person, and offers but little inducement for anyone to be keenly alive at all times to the advancement of interests other than his own.

It may be urged that the system of bonuses necessitates a great deal of thought at the outset, requires adjustment from time to time as conditions alter, and is unwieldly for ledger accounts, while the chances of personal friction amongst the various recipients are not remote.

The answer to these side issues is that such forms of extra remuneration have been shown to pay handsomely in towns where prospects were none too rosy for an early return on capital expended; manufacturers and salesmen of all kinds profit by such measures to such an extent that it would be doubly hard to meet competition by any other method, and there is no valid reason why electricity undertakings should not follow in the wake, provided that proper provisions are made for the measurement of coal, oil, water, &c., and electrical energy generated and sold. The incentive offered would do much to advance the interests of both employers and staff, and sharpen the faculties of observation and operation of all concerned with beneficial results.

EDUCATION AT PUBLIC SCHOOLS.

The *Nineteenth Century* for December and January contained a pair of notable articles upon the education provided at public schools, from the pens of Sir Oliver Lodge and Mr. A. C. Benson, of Eton, respectively. In the former number, taking a book entitled "The Schoolmaster," recently written by Mr. Benson, as his text, Sir Oliver Lodge essays a terrible indictment of public schools on the ground that they give an education wholly inefficient from the intellectual standpoint, and that, judging from Mr. Benson's own attitude and expressions, the headmasters of such schools are perfectly satisfied with what they are doing. In his reply Mr. Benson "fully and entirely agrees with Sir Oliver Lodge that the intellectual outlook in public school education is not encouraging, and that the methods pursued are not such as are calculated to produce intellectual interest." We should be sorry to deny that Sir Oliver has made out his case, convicting the system of intellectual failure from the mouth of one of its most respected and successful exponents. That is to say, Sir Oliver has made out his case so far as it goes; but equally, so far as they go, Mr. Benson has made several good points in defence. Mr. Benson admits that public schools do not provide a satisfactory education, from the intellectual aspect, for boys of average or moderate ability and for those of decidedly inferior capacity; but he urges that the training received by boys of undoubted ability, specialists and so forth, is on the whole a good one. This is as it may be: at any rate, the boy of ability will learn in the most adverse circumstances, for the phenomenon of interestingness, of which we have heard so much lately, is more largely subjective than objective. That is an uncontrovertible fact, which perhaps only the headmaster can realise; for the specialised teacher only achieves renown in his special subject because he specially understands it; he has gained special knowledge of it

because his love for it has led him to study it principally—or perhaps because his special attention to it has made him love it specially—and, therefore, he commits the blunder of thinking that all the boys he meets must be embryo lovers of the same subject, because of what he erroneously believes to be its intrinsic interest. The classicist, experimental scientist, and mathematician each make this mistake; but it cannot be proved, certainly has not yet been proved, that the effect of pumping science into a boy who leans toward history is happier than that of flogging the classics into the young musician. Where the headmaster of a public school has a great advantage over everybody else is in the number of boys of different types he meets, in the facility he may acquire of prognosing each boy's characteristics, and in the opportunity he has of seeing whether his method of dealing with that boy has been successful. And that is why, also, large public schools with a broad-minded and self-reliant head have one advantage (not all the advantages) over smaller establishments; because the magnitude and wealth of the foundation permit the employment of a specialist teacher in every branch, among whom the principal can distribute the pupils according to their bent. In the smaller school, the solitary master, or the two or three, strive to force their boys to take up the teacher's own subjects, to the greater glory of the school.

But Mr. Benson is on stronger ground where he states that schools provide the kind of education which the British parent demands, except where the head is so powerful as to be able to impose his views upon his pupils' parents. Neither the schoolmaster nor the shopkeeper can sell an article which nobody will buy. A boy will not worship at the shrine of knowledge if for three months in the year he associates with persons, whom rightfully he has been taught to honour above all else, who go through life with complacent acceptation of their own ignorance. If parents cannot be taught that they would have succeeded better in life for a wider and deeper education, or that conditions have changed since they were young and education has become more necessary, the schoolmaster who constantly urges upon the boy the need for study is implicitly inculcating a contempt for the boy's parents, which, were he acute enough to discover it, John Bull would properly resent in no measured terms. Moreover, Mr. Bull has permitted the creation, or accepts the dictation, of a host of examining bodies whose requirements have become so inclusive that a vitalised encyclopædia, uncoached in the art of passing, would stand a fair chance of being spun. What, by the way, is the average coach, but a mental costumier who lends out garments, guaranteed not to wear, for the ensuing masquerade? This being so, a school must provide classes in every subject of every entrance examination which any of its pupils may have to pass, and apart from the expense of retaining the necessary teachers, school-hours become as sub-divided, the information as disconnected, and the teaching nearly as superficial as the contents of a popular weekly magazine. Incidentally, it were an important question to solve, whether the popularity of these trivial and useless magazines is a cause, or an effect, of the disfavour with which the majority of Englishmen tacitly regard mental distinction.

But there is another aspect of the present subject, which Mr. Benson has hinted at. The headmaster sees and knows that there are all sorts and conditions of boys; the specialised teacher comes more in contact with that particular type which shows symptoms, or which is believed by its parents to show symptoms, of capacity for intellectual training. It is necessary for our success, maybe our very existence, as an important nation, that as many as possible of the growing generation who inherit or possess brains fit for education shall be trained to the utmost possible extent; but there remains a large proportion of our boys and girls who by no ideal process of education could be made intellectual. In the existing state of civilised life, too, there remain, and always must remain, a host of employments for which intellectuality is not requisite, for our political, social, and commercial forces need the private as much as the army does. Though standing on a lower plane than the officer, the work of the rank and file must not be despised, for it is equally necessary to the welfare of the community; and, as there must always be more privates than officers — certainly than commanding officers—in the army, so there must be more clerks, cashiers, salesmen, &c., than employers and capitalists in commerce. So long as "commissions" in commerce are not obtained by purchase, but by evidence of training and by promotion from the ranks, the subordinate will have been given a sufficient education if he is taught commercial arithmetic, the forgotten art of handwriting, &c. The chief non-specialised requirements of the subordinate are precisely those which make him the best citizen: Obedience to sensible Government and authority, methodical habits, truthfulness, sobriety, a general acquaintance with the history and traditions of our race, honesty, what the "gentleman" understands by "honour," and above all good health. These are the things which are specially encouraged, if not taught, in our large public schools; and if they do not make a man intellectual, they produce a man who can go anywhere and do anything (though not always at the first attempt) in a way which other systems of more intellectual education, maybe, have yet to demonstrate their ability to perform with an equal amount of perfection.

Royal Society.—The following papers were down for reading last week:—"The Relation between Solar Prominences and Terrestrial Magnetism," by Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer. "The Bending of Electric Waves round a Conducting Obstacle," by H. M. Macdonald, F.R.S. Yesterday's meeting was postponed in consequence of the death of Sir Geo. Gabriel Stokes.

PREPARATION OF METALLIC CALCIUM BY ELECTROLYSIS.

Borchers and Stockem have described in the *Zeits. für Elektrochemie*, a simple process for winning metallic calcium by igneous electrolysis of its chloride or fluoride at a temperature above the melting point of the salt, but below that of the metal itself. The apparatus consists of a cylindrical cell built of dovetailed carbon blocks, with a bottom made of some good heat conductor, insulated from the sides by means of a covering of fire-clay or the like. Centrally from the base an iron wire projects upwards, nearly to the top of the molten electrolyte, the wire serving as cathode, while the carbon walls of the cell are the anode. This method of construction was adopted because it was found desirable to have the anode as large, and the cathode as small, as possible. To make the cell tight, it is rammed with calcium fluoride, or fluorspar, and then charged with calcium chloride. Three small carbon pencils are laid horizontally and symmetrically from the point of the iron cathode to the sides of the bath, and the current is turned on, pushing the temperature till the calcium chloride melts, which is at a moderate but distinctly visible red heat, the rods being then removed. The calcium chloride dissociates, and the reduced metal collects round the apex of the cathode as a sponge, which does not fuse because the temperature is insufficient. If the sponge is lifted out as it is, and quenched in some liquid containing no oxygen, rock oil for instance, a product is obtained which contains about 50 or 60 per cent. of metal. But if the crude material is well squeezed while still in the bath by means of a pair of previously heated tongs of suitable shape, much of the calcium chloride mechanically retained can be removed, and when cold a fairly compact metal is won, which contains about 90 per cent. of elemental calcium.

This 90 per cent. metal can easily be refined by melting it in the absence of air; when, after cooling, a red crystalline layer above the purified metal is recovered. These crystals have been examined by Klockmann, who finds them to be perfectly transparent, and to have a pale red or deepish violet colour due to interference of light. They belong to the mono- or tri-clinic system of crystallisation, take up hydrogen from the moisture of the atmosphere, and eventually are converted into a mixture of calcium chloride and calcium hydroxide. Analyses of the pure crystals give figures for the chlorine-content which show them to be a calcium sub chloride, $CaCl$. Calcium fluoride may be used as the electrolyte instead of calcium chloride, if preferred.

In the same journal Arndt has described a simpler form of apparatus for the same purpose. It consists of an iron crucible lined internally with a paste of kaolin and water, and coated on the bottom with an extra layer of calcium fluoride; the whole being dried for 24 hours in a warm place. A carbon rod is employed as anode, the cathode being an iron wire enclosed in a porcelain tube to within 4 cm. of its lower end. To keep the vessel cool, it is simply stood on a massive block of cast-iron. The crucible is filled with anhydrous calcium chloride, and an arc is struck between the anode and a carbon rod temporarily held in the hand till the current passes freely through the bath. The second rod is then withdrawn, and the current is maintained at a pressure of 20 to 25 volts in order to keep the electrolyte in quiet fusion. At the end of the operation metallic calcium is obtained in well-fused large masses, which can be readily hammered or filed. A fresh surface is nearly white in colour, but it quickly turns yellowish. On analysis the yield is shown to be a metal of 99 per cent. purity, with 0·1 per cent. of silicon, but no iron or aluminium.

Calcium Carbide.—Another use for calcium carbide, which has the advantage of providing an outlet for low-grade material and dust, has been found in the vineyards of the Continent. As is well known, it is customary at intervals to spray the vines with a solution of copper sulphate, about 15,000 tons of this salt being used annually in France alone. Hitherto the solution has been put into a portable pump which is worked by hand, thus leaving only one of the operator's hands free to direct the stream of liquid to the desired spot. Now the apparatus is constructed in conjunction with a small reservoir containing calcium carbide which, by certain mechanism, is allowed to drop into the liquid by degrees. The evolution of acetylene so produced sets up pressure in the apparatus sufficient in amount to force the copper sulphate solution out as a steady jet, and so both hands of the man carrying the vessel remain at liberty. It is also stated that the acetylene, some of which dissolves in the liquid, and the calcium hydroxide, or slaked lime, formed as the by-product of the chemical reaction, assist the copper sulphate in its cleansing action upon the plants. It would seem, however, as if the plan of allowing the carbide to fall into the copper sulphate solution might give trouble in the apparatus by an eventual blocking of the jet and leading tube, because not all the lime would be in a state of solution, and whether it were dissolved or merely suspended, it would tend to react with the copper sulphate to form an insoluble copper hydroxide. Should this difficulty arise in practice, it could easily be overcome by making the carbide come in contact with a suitable quantity of water kept separate from the active solution, thus imitating more exactly, in fact, the construction of the ordinary "saltzogene."

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,421A, 1902. "Improvements in electro-magnetic releasing mechaniam for electric switches or cut-outs." C. M. DORMAN and R. A. SMITH. (Date claimed under Patents, Rule 19, October 15th, 1902.) January 20th. (Complete.)

1,239. "A combined traction telephone and fire alarm or municipal telegraph." A. C. BROWN. January 19th.

1,255. "Improvements in and connected with electric trolley standards." R. H. RAINS. January 19th.

1,259. "Improvements in or relating to electrical motors, dynamos and the like." H. T. LOGAN. January 19th.

1,270 "Improvements in electric switches." A. S. MOORE. January 19th

1,295. "Automatic and electrical railway working and controlling safety system." D. M. DABOO. January 19th.

1,299. "Improvements in or relating to safety appliances for the prevention of injury where a trolley line or other live conductor breaks." W. H. STEWART. January 19th.

1,320. "Improvements in electrically-controlled power transmitting and speed changing apparatus." L. J. Le PONTOIS. January 19th. (Complete.)

1,334. "Improvements in electric arc lamps." O. KOHN and M. ABT. January 19th.

1,416. "An improvement in miners' electric lamps." H. G. PRESTED. January 20th.

1,417. "An improvement in collecting electric currents from armatures of unipolar dynamo-electric machines." F. E. ELMORE. January 20th.

1,467. "Improvements in party line telephone circuits." H. S. DISTIN and A. SIBERRY. January 21st.

1,488. "Improved apparatus for recording telephone or other oral communications." A. CRYER and E. C. NEWBY. January 21st.

1,514. "Improvements in clockwork operated electro-magnetic circuit controlling apparatus." M. DANZIGER. January 21st.

1,516. "Improvements in circuit breakers or interrupters suitable for the electric igniting devices of automobiles worked by internal combustion engines." A. FOUET. January 21st. (Complete.)

1,529. "Improvements in insulating material for dynamo-electric machines, electric motors and conductors." H. OLIVER and G. J. PHILPOTT. January 22nd.

1,540. "Improvements in means for metering and registering electrical energy to be charged for under varying conditions of supply." THE ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD., and L. J. ARON. January 22nd.

1,563. "Improvements in electricity meters." H. NUNNS. January 22nd.

1,634. "An improved trolley frame and bracket for use in electric overhead tramcars and the like." W. HUNT. January 23rd.

1,635. "An improved method of insulating and fixing electrical switches, &c." C. S. NORTHCOTE. January 23rd.

1,638. "System of electric goods traction." T. R. OLLERENSHAW and E. C. HOEGERSTAEDT. October 28rd.

1,670. "Method of generating electricity." J. H. REID. January 23rd. (Complete.)

1,716. "The electric egg-beater." G. F. BLAKE. January 23rd.

1,735. "Improvements in insulators for electric wires or cables." J. STANWAY, A. R. FREAKLEY, F. BURTON and E. COOKE. January 24th.

1,748. "Generating electricity from the force of the sea." G. W. PATTERSON. January 24th.

1,749. "Device for carrying guard wires of trolley wire systems." J. K. FORREST. January 24th.

1,776. "Improvements in electric switches." C. E. HUNTER and P. HULME. January 24th.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

13,301. "Improvements relating to steam engine, telegraph, and similar apparatus." E. Arfelt. Dated June 29th, 1901.

13,351. "Process of a material for insulating conductors.' C. [E. Woods. Dated July 1st, 1901.

13,365. "Process of separating the matrices from galvano-plastically precipitated." C. E. Steinweg. Dated July 1st, 1901.

13,367. "Improvements in electric furnaces for dental and other purposes." R. Winter. Dated July 1st, 1901.

13,402. "Improvements in self-exciting alternating current dynamos." M. Latour. Dated July 1st, 1901.

13,415. "Improved holder for electric incandescent lamps." G. Wallace. Dated July 2nd, 1901.

13,478. "Improvements in electric railways with overhead collectors." C. Bach and K. Richard. Dated July 2nd, 1901.

13,563. "Improvements in and relating to the transmission of electrical energy." H. H. Lake. (N. Tesla.) Dated July 3rd, 1901.

13,568. "Improvements in plates for electric accumulators." D. Tommasi. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, January 17th.) Dated July 3rd, 1901.

13,577. "Improvements in electrical fuses for high tension." P. Loescher. Dated July 3rd, 1901.

13,623. "Improvements in push switches for electric bells." British Thomson-Houston Co. and A. S. Cubitt. Dated July 4th, 1901.

13,662. "Improvements in electrolytic cells." J. Raschen and United Alkali Co. (Grant of patent opposed.) Dated July 4th, 1901.

13,665. "Improvements in holders for Nernst lamps." E. G. Sheppard, G. S. Ram, and Nernst Electric Light Co. Dated July 4th, 1901.

13,666. "Improvements in lampholders for electrolytic lamps." B. M. Drake and Nernst Electric Light. Dated July 4th, 1901.

13,732. "Method of and apparatus for effecting electric traction on tramways." C. D. Abel. (Soc. Anon. pour la Transmission de la Force par l'Electricité.) Dated July 5th, 1901.

13,738. "Improved means for preventing sparking at the collector of dynamo-electric machines." A. Heyland. Dated July 5th, 1901.

13,940. "System of vacuum tube lighting and dynamo machine for use in connection therewith." W. L. Wise. (More Electrical Co.) Dated July 9th, 1901.

13,957. "Improvements in controllers for electric motors." British Thomson-Houston Co. (J. B. Limm.) Dated July 9th, 1901.

13,959. "Improvements in indicating devices for electrical measuring and other instruments." British Thomson-Houston Co. (C. P. Haskins.) Dated July 9th, 1901.

13,981. "Improvements in inductance and induction coils." H. Shoemaker and G. P. Gehring. Dated July 8th, 1901.

13,984. "Improvements in or relating to electrical storage batteries." H. K. P. Barham. Dated July 9th, 1901.

13,985. "Improvements in electric cables." G. G. M. Hardingham. (Felten and Guilleaume Carlswerk Actiengesellschaft.) Dated July 9th, 1901.

14,049. "Improvements in trolley heads for electric tramcars." J. H. F. Bale. Dated July 10th, 1901.

14,086. "Improvements in the construction of electrodes for accumulator batteries, and in moulds therefor." R. J. Gulcher. Dated July 10th, 1901.

14,219. "Improvements in means and apparatus for operating and controlling telegraphic and other apparatus or mechanism from a distance without wire or other like conductors." J. T. Armstrong and A. Orling. (Patent not yet due for sealing.) Dated July 12th, 1901.

14,236. "Improvements in the working and controlling of electrically-driven cars." Siemens Bros. & Co., and A. Siemens. Dated July 12th, 1901.

14,237. "Improvements in and connected with electric arc lamps." J. O. Girdlestone and C. F. G. Thorkelin. Dated July 12th, 1901.

14,411. "Improvements in and relating to the manufacture of filaments and other conductive bodies for incandescent electric lamps and heaters." W. E. Sander. Dated July 15th, 1901.

14,422. "A combined telephone, telegraph, electric light and power system." A. M. Stark. Dated July 15th, 1901.

14,457. "Improvements in and relating to typewriting, telegraph and similar machines and apparatus to be used in connection therewith." J. Largarde. Dated July 16th, 1901.

14,490. "Improvements in electric lamp hangers." H. J. Harrison. Dated July 16th, 1901.

14,511. "Improvements in electric light apparatus for medicinal purposes." A. W. Marshall and M. W. Woods. Dated July 16th, 1901.

14,562. "Improvements in alternating current electricity meters." F. L. Catenhusen. Dated July 17th, 1901.

14,579. "Improvements in and relating to the transmission of electrical energy." H. H. Lake. (N. Tesla.) Dated July 17th, 1901.

14,624. "Improvements in moving coil electrical measuring instruments." A. Eckstein and F. Panter. Dated July 18th, 1901.

14,643. "Electric furnace arranged for being oscillated or tipped." J. Imray. (Soc. Electro-Metallurgique Francaise.) Dated July 18th, 1901.

14,807. "Improvements in contact ploughs and conduits for electrically-propelled cars." A. N. Connett. Dated July 20th, 1901.

14,813. "Improvements in or relating to trolleys and like current collectors for electric railways and tramways." G. A. Menlove. Dated July 20th, 1901.

14,822. "An improvement in electrolytic apparatus." J. G. A. Rhodin. Dated July 20th, 1901.

14,825. "Electro-metallurgical treatment of zinc ores and especially blend." C. J. Tossizza. Dated July 20th, 1901.

14,826. "Improvements in apparatus for exhausting electric glow lamps." O. Imray. (P. Scharf.) Dated July 20th, 1901.

14,897. "Improvements in electric meters." P. Rieunier. Dated July 22nd, 1901.

14,919. "Improvements in couplers for connecting together the ends of wires, conductors and the like." E. Fischer-Schaad and H. Schneider. Dated July 22nd, 1901.

14,930. "Improved means for holding and working trolley poles on electric railway and tramway vehicles." J. Parsons. Dated July 23rd, 1901.

14,931. "Improvements in and relating to electric meters." W. McWhirter. Dated July 23rd, 1901.

14,948. "Improvements in electrical brush-holders." T. Wilson and A. Wilson. Dated July 23rd, 1901.

14,946. "Improvements in and connected with electrolytic apparatus." M. Haas. Dated July 23rd, 1901.

14,963. "Improvements in electric arc lamps." J. A. Heany. Dated July 23rd, 1901.

14,967. "Improvements in apparatus for refining metals by electrolysis." P. M. Lincoln. Dated July 23rd, 1901.

14,969. "Improvements in electric synchronism and frequency of speed indicators." P. M. Lincoln. Dated July 23rd, 1901.

14,996. "Improvements in electric motors." J. A. Heany. Dated July 23rd, 1901.

14,997. "Improvements in electric motors." J. A. Heany. Dated July 23rd, 1901.

14,998. "Improvements in electric arc lamps." J. A. Heany. Dated July 23rd, 1901.

15,069. "An improved lead fuse for electrical plants." F. H. Krebs. Dated July 24th, 1901.

15,087. "Improvements in electric percussion drills or tools." F. H. Loring. Dated July 24th, 1902. (Patent not yet due for sealing.)

15,130. "Improvements relating to electric stoves or heaters." A. E. Greville. Dated July 25th, 1901.

15,146. "Improvements in trolley stands for electric cars." G. C. Marks. (E. J. Parker and A. S. Paton.) Dated July 25th, 1901.

15,149. "Improvements in and connected with the protection or covering of underground cables." O. Wilhelmi. Dated July 25th, 1901.

15,190. "Improvements in systems of control for electrically-propelled vehicles." British Thomson-Houston Co. (F. E. Case.) Dated July 26th, 1901.

15,195. "Improvements in supporting conductors in conduit systems of electric railways." W. Chapman. Dated July 26th, 1901.

15,239. "Improvements connected with electrical cut-outs and partly applicable to electrical switches." E. E. Bartlett. Dated July 27th, 1901.

15,242. "Automatic self-righting motion of swivelling trolley wheels on electric tramcars." T. B. Birkby and F. E. Birkby. Dated July 27th, 1901.

15,258. "Improved means for raising, lowering and suspending arc lamps." J. T. Irwin and Willans & Robinson. Dated July 27th, 1901.

15,322. "Improved liquid starting resistance for electro-motors and the like." V. I. Feeny. (Allgemeine Electricitäts Gesellschaft.) Dated July 29th, 1901.

15,368. "A safety device for exposed electric leads." Siemens Bros. & Co. (Siemens & Halske Aktiengellschaft.) Dated July 29th, 1901.

15,370. "Improvements in electric meters for measuring electromotive force or current strength." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft.) Dated July 29th, 1901.

15,371. "Improvements in electric switches." P. W. P. Hodges. Dated July 29th, 1901.

15,391. "Improvements in and connected with carbon brushes for electric generators or motors." T. C. Parsons. Dated July 30th, 1901.

15,427. "Improved process for the electrolytic deposition of metals and alloys." P. Marino, Q. Marino, G. Marino and A. Ratchkowsky. Dated July 30th, 1901.

15,448. "Improvements in recorders for use in submarine telegraphy." M. J. Peleuc. Dated July 30th, 1901.

15,460. "Improvements in electric clocks." W. L. Wise. (Actiengesellschaft "Magneta." Elektrische Uhren ohne Batterie und ohne Contact.) Dated July 30th, 1901.

15,467. "Improvements in and connected with wireless telegraphy and other signalling." J. C. Rose and S. C. Bull. Dated July 30th, 1901.